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ABSTRACT

This guide presents a curriculum for a volunteer field aide program. The guide is based on a program that was conducted in New Hampshire that trained volunteers to assist teachers in outdoor environmental education ventures. It was found that the aides helped teachers to expand their existing programs by assisting in supervision, research and program development, and instruction. This guide provides a framework for other teacher groups wishing to develop an aide program. The volunteer aide program is based on 15 sessions of inter-disciplinary environmental education instruction. These activities and concepts in the 15 sessions are aimed at familiarizing the aide with ecological concepts, techniques for field work with children, and teaching approaches stressing inquiry and discovery. The 15 sessions, which cover such topics as the inquiry approach, classifying, field and forest communities, compass and mapping skills, and mathematics, are covered in the guide. Each session focuses on one topic and includes activities, suggestions, references, diagrams, and illustrations. Suggestions for organizing an aide program, sample registration forms, a bibliography and resources are also included. (TK)

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A MANUAL FOR A VOLUNTEER FIELD AIDE PROGRAM

HANOVER
Conservation
COUNCIL

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Symbol of the Hanover Conservation Council
designed by John Scotford, College Designer,
Dartmouth College.

Preface

The volunteer field aide program described in this booklet was initiated in response to requests from teachers of the elementary and middle schools of Hanover, New Hampshire, and Norwich, Vermont, for assistance in introducing environmental studies and extending these studies beyond the classroom. It has now been in existence for two years of trial, error, and improvement, and will continue to be developed in ways which will more effectively meet the needs of these schools and communities.

Sufficient time has elapsed, however, for a number of benefits to be clearly apparent. The program has, foreseeably, stimulated environmental studies in classrooms. Training courses, which now include teachers as well as aides, have provided personnel with expertise for more effective use by students and teachers of natural resource areas on school sites and throughout the towns. In addition to the aides, other individuals with special skills and knowledge have been involved in training sessions and field work. Unplanned dividends have been the benefits to the adult participants—acquisition of more knowledge about the ecology of the area by aides and teachers, opportunities to learn more about and contribute to school activities by the experts—and the consequent improvement of school-community understanding.

Hanover and Norwich are relatively small Upper Connecticut Valley towns with considerable rural poverty and a heavy dependence on property taxes for school support. They have only limited resources for the development of an environmental studies program and limited opportunities for teacher training in this area. However, they have a wealth of accessible natural areas for teaching purposes and many knowledgeable persons whose expertise is just beginning to be tapped.

Many communities in northern New England share Hanover's and Norwich's problems and are equally aware of the need to educate citizens to environmental problems and their solutions. It is in the hope that the experience of these communities will provide encouragement and sufficient information for others to "go and do likewise" that the following description of the Hanover Volunteer Field Aide Program (which serves Norwich as well) has been made available.

This booklet was prepared by Mrs. Allie Quinn, chairman of the Education Committee of the Hanover Conservation Council, and the person most responsible for the development of the aide program. It was printed with New Hampshire-Tomorrow funds and will be distributed at no cost to all New Hampshire schools through the office of William Ewert, Science Consultant for the New Hampshire Department of Education. Additional copies may be secured for $1.50 from the Regional Center for Educational Training, Wilson Hall, Hanover, N.H., the sponsoring agency.

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A Teacher's Evaluation

Up-country, our schools are often within walking distance of fields and brooks and woods. As elementary teachers, we would like to do our bit by the environment! This could be a meaningful science program the kids would enjoy. But some of us would have to confess that science is not our strong subject.

We are urged to "take the children outdoors!" Practical people that we are, this conjures up visions of thirty children running ahead, lagging behind, getting lost???

The Hanover Conservation Council came to our rescue by offering the schools a program of training Field Aides—volunteer mothers who take part in a series of workshops and field trips, doing many of the things themselves that they would later do with small groups of children.

A single phone call to the director, Mrs. Allie Quinn, and we soon have before us several mothers ready, willing, and able to go with us to study ponds, woodlots, tracks in the snow, brooks, insects, gardening, erosion.

In my first encounter with Field Aides, I was afraid they would find out how little I knew. However, we usually pooled our ideas and know-how, and I now feel we are a team learning together.

From a busy teacher's standpoint, the Field Aides help us expand our present science activities. They round up materials; upon request, they have come in the day before to plan with the teacher, or to evaluate afterward. They will work indoors, too, with planta, aquaria and terraria, or any ecology study that works best in small groups. They see the classroom and the children as they are; they note needs for materials; invariably they are the school's strongest supporters.

From a child's standpoint, they are always glad to see the Field Aides coming. In a group of 4 to 6, each child will have many opportunities to ask and to tell. Some children have a lot to contribute to the study of things outdoors—this is their chance to shine. And they are excited to be a part of saving our environment!

The teachers are helped in a most practical and necessary way. The kids are learning and happy, "doing" science. And the community is pleased that tomorrow's citizens will know and care about their environment.

Frances W. Kelsey
Grade 4 Teacher
Ray School
Hanover

"The aim of environmental education is to develop a citizenry that is knowledgeable concerning the bio-physical environment and its associated problems, knows how to help resolve them, and is motivated to do so." (Definition developed by members of the School of Natural Resources, University of Michigan.)

HANOVER ENVIRONMENTAL AIDE PROGRAM

Introduction

Between 1970 and 1972 forty women in Hanover and West Lebanon, New Hampshire, and Norwich, Vermont, participated in a volunteer environmental aide program for the local elementary and middle schools. Three training courses, varying from twelve to fourteen sessions each, were organized and run by Hanover's Director of Environmental Studies and the education director of the Hanover Conservation Council. A fourth training program for both teachers and aides was held in the fall of 1972.

There seems to be a growing need for trained volunteers qualified to assist teachers in their environmental education efforts, and particularly in the outdoor phases of these activities. It is hoped that this manual, based on the Hanover program to date, will be useful to other schools and communities which might wish to start such a program.

Genesis

The Hanover environmental aide program is an outgrowth of efforts going back to 1969 when a new elementary school was under construction. Several teachers and local citizens saw development of the new school site as an opportunity for innovation in environmental education in the school system. With approval of school supervisory personnel, a planning committee was organized, involving teachers, interested community members, and a school board representative. This group quickly expanded its scope to include use of outdoor areas at all schools and other suitable community properties.

A number of teachers reported interest but uncertainty as to how environmental studies should be added into the school curriculum. Even teachers already committed to starting programs expressed difficulties, which may be summarized as follows:

1. The science of ecology is relatively new, and few teachers have had any exposure to its concepts in the course of their formal training.
2. Teachers, especially of elementary aged children, have only rarely been exposed to techniques for field work, and almost never to multidisciplinary problem-solving approaches.
3. Teachers cannot constructively cope with as large numbers of students in a field situation as in the classroom. For example, teachers feel that five to seven elementary students with a leader makes an effective working unit.
4. Teachers often do not think of the out-of-doors as a means of carrying out classroom objectives. With the necessary help, outdoor activities may be very effective in initiating, implementing, and extending the classroom program.
5. A large percentage of teachers are familiar neither with the natural history nor the social structure of the towns in which they teach. This may be because they are newcomers or because they lack prior interest or exposure. They are "uncomfortable" outside the safety of their classrooms.
6. Teachers do not know what area resources—both human and physical—are available to them.

What has been accomplished in the Hanover program to date?

Beyond the laying out of simple nature trails, efforts of the program have been largely directed toward these above-stated teacher needs. Extensive resource materials have been collected, several teacher workshops held, and volunteer aides recruited and given training.

However, the program still reflects its low-key, grassroots beginnings. It has had administrative approval but little priority or money. Free resources and volunteer assistance have been relied upon, and the limited funds required have been met by community organizations and New Hampshire-Tomorrow. Teacher involvement, based on interest alone, has been uneven but is increasing steadily. Resulting curriculum development has been significant at some levels. At others, further experience is required before a coordinated program can proceed. Enough volunteer aides have now been trained to have a noticeable impact, though better mechanisms for coordinating the aide program are needed.

Many people feel that the availability of volunteer help has been the key element in getting an environmental studies program started and in building up momentum. These aides have brought interest, enthusiasm, knowledge of the local community, various skills and competencies, and (not least) community support for the program. With such assistance, more and more teachers are willing and able to participate.

Environmental Aide Program — Some Suggestions

What can an environmental aide program contribute?

1. Such a program can provide specific assistance to hard-pressed teachers by:
   a. Providing greater adult supervision, thus making possible increased outdoor educational experiences
   b. Providing help in searching out and collecting resource materials and/or equipment for class environmental studies projects
   c. Bringing additional skills, knowledge, or experience to enrich the offerings the teacher can provide
   d. Providing liaison to other community resources
2. Such a program will also stimulate general community interest and involvement in the school program.

How does someone go about starting an aide program? What are some general guidelines?

1. A volunteer aide program may be started as a result of efforts by: a school principal; a teacher or group of teachers; or individuals or organizations in the community. However initiated, the program must have the support of school supervisory personnel. It cannot be imposed from outside.
2. There should be some mechanism within the school system for coordinating the volunteer program. While much of the work may be done by one or more of the volunteers, it is soon essential to have some readily available clearinghouse within the school.
3. The environmental aide program must be designed to fit the skills and requirements of volunteers to the particular circumstances of the school and the needs of its teachers.
4. Environmental aides should have a recognized role in the school. Care should be taken to introduce them to principals, teachers, and students and to explain what they will be doing in the school.

What should the relationship be between teachers and aides?

1. Each teacher should explain her classroom organization and philosophy to aides assisting her.
2. The aim should be to develop "teaching teams," with each teacher firmly in charge and setting the framework for the program and with each member of the "team" having something to contribute.
3. Help from teachers will be required for further training of the aides. After an orientation course of 20-25 hours, aides will still need much supervision and professional guidance by teachers. This will take teacher time and effort but should have important long-term payoffs.
4. The work of the environmental aide should not be just babysitting but should be related to school curriculum. The environmental aide is contributing much time and effort both in the training course and in volunteer time and needs to feel that she is making a worthwhile contribution.
5. As much as possible, aides should have some appropriate degree of involvement in planning for curriculum in which they will be extensively involved. To be effective in particular sessions, aides must understand how these activities fit into the overall program.

6. It is helpful and requires less central coordination if aides can work on a regular schedule. However, this may not meet the varying needs of teachers for assistance, family obligations of volunteers, vagaries of the weather, or seasonal requirements. Initially a flexible scheduling arrangement will probably be advisable. Later more stable arrangements may be able to be worked out.

What are the problems to look out for?

1. Many teachers feel uneasy with outsiders in their classrooms or with assistants who may have more background in a subject than they. Thus, it may be helpful in the beginning to have teacher and aide work together long enough (through a complete project) to develop the supportive or team approach in which the benefits are obvious to each.
2. Whatever the long-term benefits, the use of aides does place demands on a teacher's time. "It takes time to save time."
3. Even after training, aides vary greatly in their competencies and in their self-assurance about working with children. Some have been teachers, some are competent in relevant academic disciplines, some have expertise as local naturalists, and some bring little more than a desire to be helpful. This requires considerable care in placement and follow-up.
4. Volunteers are usually not as reliable in keeping to schedules as paid workers, whether because of other obligations or just lesser personal commitment.
5. It is more difficult to give orders or enforce rules on unpaid volunteers, although such supervision is often essential to the smooth working of a school system.
6. In some cases it is disruptive to have a parent assisting in her own child's class. In other cases parents prefer this, and it works out well. This must be worked out to the satisfaction of both teacher and parent involved.

FIELD AIDE CLASS

REGISTRATION-FALL 1972

NAME:

ADDRESS:

PHONE:

The purpose of this questionnaire is to help us better tailor this course to the needs and experience of the group.

1. Are you now supporting any environment-related organizations? Which?

2. If you attended college, graduate school, or specialized school:

NAME	SUBJECT/MAJOR	DEGREE

3. Have you had experience teaching elementary or secondary age children? (Include school, aide, scouts, Sunday School, etc.) Explain.

4. Do you have any special interests or hobbies or have you had any special experiences which might be related to outdoor education (including interests you may have shared with your children)?

5. Do you prefer to help in a class containing one of your children (if any)?
Yes _____ No _____ Doesn't matter _____.

6. Please give the following information for each of your children who may be in elementary or secondary school:

NAME	SCHOOL	GRADE LEVEL	TEACHER(S)

FIELD AIDE CLASS
REGISTRATION-FALL 1972

NAME:

ADDRESS:

PHONE:

Please indicate below those times when you can not attend a class or practice session, giving hours when you have a conflict. If you have strong preferences, indicate these and they will be taken into consideration as much as possible.

	Morning (9-12)		Afternoon (12:30-3)		Afternoon (3-5)	
	Can Not	Prefer not	Can Not	Prefer not	Can Not	Prefer not
Monday						
Tuesday						
Wednesday						
Thursday						
Friday						

Do you know now of any periods when you will be out of town or unable to attend class?

Sometimes it is difficult to mesh the schedules of the group with those of our field trip leaders. If a weekend trip should be necessary, would you prefer:

Saturday morning _____ afternoon _____
Sunday morning _____ afternoon _____?

Training Course for Environmental Aides – A Format

Who should run the course?

Overall supervision of the course could be by anyone—knowledgeable teacher, department head, curriculum coordinator, or administrator familiar with the structure of the school(s) involved and the needs of the teachers to be served. A teacher-community committee would be helpful to provide assistance in defining needs and designing the most appropriate course. Actual running of the course (recruiting of participants, arrangements, scheduling, course materials, etc.) can be carried out by a volunteer course coordinator.

How much will such a course cost and how can it be financed?

The cost of running such a course will vary according to the situation. It could involve instructors' fees or expenses, materials for course participants, paid release time for a teacher-director and a course and/or program coordinator. If necessary, however, it should be possible to set up a course requiring little or no direct financial outlay.

Instructors for the various class sessions are often available without fee, or for expenses only, from government agencies, nearby colleges and schools, the local school system itself, or the community. Materials can usually be reproduced within the school system if it has its own reproducing facilities. If necessary, a small fee could be charged course participants to cover these costs.

If a competent volunteer is willing to take on the duties of course coordinator, the amount of time required from a course director or other school personnel should not be significant. For personnel already overburdened, however, some time released from teaching or other duties is desirable.

Some additional expenditures may be needed for reference materials and simple equipment. These should fall within the budget for normal curriculum development, but there may be some problem of timing.

Minor expenses which cannot be met within the school budget or by the utilization of volunteer assistance will need to be covered from community or outside sources. In New Hampshire the Science Consultant for the Department of Education, presently William Ewert, can advise on outside funding sources applicable to a particular program proposal. However, the Hanover experience is that the best source for small supplementary funding is the community itself, especially conservation organizations, parent-teacher groups, men's civic clubs, and/or town conservation commissions.

Where do you find instructors for classes and field trips?

Once a desired program has been drawn up by the course director and/or course committee, it should not be difficult to find instructors for each session. Good outside sources for instructors are the U.S. Soil Conservation Service, Resource Conservation and Development projects, U.S. Forest Service, state Fish and Game, Society for the Protection of N.H. Forests, N.H. Audubon Society, state teachers colleges, and other nearby schools and colleges.

The school also should not neglect the expertise within its own system: teachers in the pertinent specialties and those especially known for effective teaching approaches or field technique. However, scheduling may make the use of such personnel difficult or may involve release time costs.

There may also be significant expertise available in the local community. Groups which might be contacted for leads include the town conservation commission, conservation groups at both state and local levels, garden clubs, the local AAUW chapter, and senior citizens' organizations.

What is a good class size?

Recommended class size is fifteen to twenty students. Since many of the volunteers will probably have small children, some attendance loss at each session is predictable. However, a class much over twenty is unwieldy for the sessions involving active participation.

How do you obtain the students-volunteers?

Recruitment of students might best be done by a volunteer who knows the community well. She* can use various approaches as appropriate: personal contact and word of mouth, take-home slips for school children, suggestions by teachers of mothers who have shown interest, notices or personal appearances at meetings of appropriate groups (i.e., parent-teacher organizations, cooperative nursery schools, conservation groups, women's organizations, senior citizens' groups), and newspaper notices.

Whatever the recruitment process, it is advisable that the coordinator personally contact each potential student to be sure she understands what the course involves and what her commitments will be afterward. The following points should be stressed, as applicable:

1. Personal benefits to the volunteer. These would include her increased enjoyment from greater knowledge of the local area; benefit to her own family; training useful for activities such as scouting, church school programs, or a teaching career; and satisfaction from providing a needed community service.
2. Scheduling of class sessions to fit needs of class members (see procedure below).
3. Flexibility in arrangements for follow-through volunteer service in the school. Some standard commitment should be agreed upon, i.e., an average of once a week, or twice a week during the good weather months. However, the arrangement should be flexible enough to meet the needs of the volunteer with family or other obligations which may on occasion block out weeks or even months of time.

How can sessions be scheduled to meet participants' and instructor's needs?

A course director fortunate enough to have ample resources in money, volunteers, or potential class instructors should have minimum difficulty in scheduling. Classes may be set at a convenient time, i.e., two hours one morning each week for the required number of weeks. However, most programs will be lacking in one or all of the desirable resources. The following scheduling procedure has proved very workable in the Hanover program.

---

* Throughout volunteers are referred to as feminine because most have been female. However, it is hoped that increasingly such volunteer programs will be able to attract men, especially among the retired, who have so much to offer the schools.

After a potential class list has been drawn up, each candidate should fill out a schedule (see example p.10) showing (1) times she cannot attend class and (2) times she prefers not to have a class scheduled. Using the same form the coordinator can make a master sheet by assigning each candidate a number and then entering that number at those times she cannot or prefers not to attend class. School vacations and periods when people will be away should also be recorded. If the Hanover experience in three courses holds true, two or three blocks of time per week will turn out to be open for everyone or almost everyone. Those candidates with conflicts should be contacted, and probably they too can make arrangements to be free on particular dates if given adequate warning.

The next step is to consult the list of desired course sessions as drawn up and sequenced by the director and/or course committee. The potential leader for each session should be contacted and given a choice among the times available in the desired week. Again, with perhaps a little juggling of course sequence, class times can usually be arranged. Two or more weeks notice is advisable for local resource people, while three to four weeks may be needed for a leader from a federal or state group.

What kind of a course do volunteer aides need?

Like the teachers they will be assisting, the aides may have had little exposure to certain subject matter—especially in ecology—or to techniques for field work with children. With the possible exception of the few former teachers, they will also have had little experience with newer, less structured teaching approaches stressing inquiry and discovery. They will also need help in knowing where to go for available resources.

Therefore, the kind of course that will be helpful for aides should incorporate the following guidelines:

1. Provide background or "framework" sessions in ecology and geology. As much as possible these should be in the field and should relate theory to the specific local areas where aides will be working.
2. Supply supplementary materials: (a) simple reference materials, and (b) suggestions for teaching projects relevant to the background sessions.
3. Actively involve aides in going through learning experiences that they might utilize with children. They will both build the "skills" of the aides, i.e., using compass or classification keys, and also give them a better understanding of teaching approaches.
4. Stress approaches of inquiry, discovery, and problem-solving in the relevant world of the child's immediate surroundings. It is not as important for the aide to know answers as how to find out or what questions will open up further inquiry avenues.
5. Emphasize: observing (with all the senses), organizing information, discovering relationships, building useful skills, and testing ideas and hypotheses.
6. During the course have student aides spend time observing in classrooms and take part in planning and carrying out activities with children.
7. Familiarize aides with teaching resources available locally—in libraries, nearby museums or resource centers, school or college collections, etc.

What specific subject matter should the course contain?

Every school situation is a little different, with its own teacher needs, resources, and curriculum. The following course outline is offered as one model which might be followed, or adapted and changed as desired:

Session	Subject
1.	Introduction to inquiry approach, teaching opportunities of the outdoors, techniques for encouraging observation and use of the senses, follow-through activities.
2.	Sorting and classifying. Why "sort" or classify, how to introduce this to children. Course participants learn to make classification keys through same techniques used with children. Science, social studies, and language arts applications.
3.	Field and forest communities, introduction to ecology. Main purpose to give background in ecological principles, explain ecological communities, succession, climax communities, etc., as seen in plant life of the local area.
4.	Field technique. What do you do with 25 children in the field when you get there? Useful approaches may be offered by field trip leaders for the background sessions; but, if not, there should be a separate session for this all-important subject.
5.	Animal life of field and forest communities. Field emphasis on role of animals in specific communities, animal signs (especially small mammals), where to look and what to look for, what children can do to find out more.
6.	Ecology and curriculum. Use of eco-system model to further investigate relationships in the living—non-living world. Examination of how ecological concepts may be built into the curriculum.
7.	Pond and stream communities. Stream field trip will emphasize plant life, animal life and where to find it, relationships to environmental factors. Pond trip will introduce life cycle of ponds, physical characteristics, life, effect of pollutants.
8.	Use of compass and mapping, taught by exercises appropriate for elementary children. Reading and making of topographical maps. Follow-up on use of topographical maps in geology field trips.
9.	Geological past of the local region. How was this area shaped by its glacial past? Visits to nearby sites which give evidence of this history. Examination of area topographical maps.
10.	The water cycle, with emphasis on soils, water, how it shapes the land, erosion, streams, and their floodplains. Field trip along a brook, to an eroding area, or other appropriate spots. Discussion of wise soil and land use practices.
11.	Mathematical techniques useful in environmental studies—recording information, graphs, measures, estimating, sampling, etc. Examples of curriculum applications.

Session	Subject
12.	Curriculum applications in language arts and social studies areas. Presentation of work with tape recorders, cameras, games, problem-solving projects, "environmental encounters," etc.
13.	Museum and library resources. Homework assignment to browse in local libraries. Conducted visit to best local resource center. If possible, include workshop on preserving natural materials and setting up displays.
14.	Field and forest in winter—on snowshoes. Field trip to discover wealth of winter activities: ice and snow, water content of snow, effect of snow cover on ecological communities, animals and trees in winter, etc.
15.	Summary session on role of the field aide. Discussion and feedback on experiences to date.

Inquiry Approach – Session 1

Leader: an experienced teacher from the school system or someone involved in teacher training.

The purpose of this session is to introduce aides to a teaching approach which emphasizes (1) learning growing out of the child's own observations and experience in the environment around him and (2) his relationship to those surroundings. It is an activity-oriented approach and involves a lot of "messing around" (see bibliography). Most of all it aims to develop a "sense of wonder."

> *I sincerely believe that for the child, and for the parent seeking to guide him, it is not half so important to "know" as to "feel." If facts are the seeds that later produce knowledge and wisdom, then the emotions and the impressions of the senses are the fertile soil in which the seeds must grow. The years of early childhood are the time to prepare the soil. Once the emotions have been aroused—a sense of the beautiful, the excitement of the new and the unknown, a feeling of sympathy, pity, admiration or love—then we wish for knowledge about the object of our emotional response. Once found, it has lasting meaning. It is more important to pave the way for the child to want to know than to put him on a diet of facts he is not ready to assimilate.*
>
> From *The Sense of Wonder* by Rachel Carson

This session can be conducted in a number of ways, but it is recommended that the aides be involved at least part of the time in "activities" with an inquiry orientation. For example:

Exercise I (½ hour)

The teacher will bring in a number of articles typical of what children bring in on a Monday morning or for "show and tell." Examples might be a rounded pebble, a bone, or a bird's nest. What can a teacher say? What kinds of questions might encourage closer observation or further inquiry? The session leader can have the aides volunteer questions and then show how some of these might lead into further learning experiences.

Questions about the rounded pebble might include the following: Does it feel rough or smooth? If you break it open, do you think it will be the same color inside as out? Where can you go to find another pebble shaped like this one? Such questions might lead to investigations into weathering or to the action of streams or waves on rock. Questions about the bone might deal with how heavy it is, whether or not it is hollow, or what part of an animal's body it might come from. Children can be encouraged to bring in bones from home—chicken bones, bones from leg roasts, ribs, etc.—to compare with the bone found. The bird's nest might raise questions as to the materials used in its construction, the location where it was found (up in tree, in shrubs, on ground, near water, etc.), where similar nests might be found, whether birds will return to a nest a second year, etc. A search for nests of different construction, design, or location might be begun, though if in the spring of the year children should be cautioned not to touch or disturb.

Exercise II (½ hour)

Each aide will select a spot out-of-doors where she will sit quietly for fifteen minutes. During that time she is to make three to five observations of anything she sees that interests her. She is then to write down one question about each observation. For example, an aide might observe that a field on one side of a fence has grass, while on the other side small pine trees and shrubs can be seen. She might ask simply, why?

When the group reassembles, each aide can read her observations and questions. The teacher might then pick several observations which have good potential for further investigations. For example,

the observation about the two fields might lead to studies of succession. This might first call for careful examination of the kinds of plants growing in each area. Children can determine the ages of the little pine trees and look for larger trees which might be the source for seeds. The children can also check the use to which the different pieces of land are being put. Is one being mowed or used for grazing?

Exercise III (¾ hour)

Divide the aides into groups of three. Give each group twenty minutes to carry out one of the projects listed below.* Then have the group reassemble with each team explaining its project and displaying the results. The teacher and group should discuss further investigations each project might lead to.

1. Take a portable tape recorder and describe several living objects on tape. Bring the objects concealed in a box back to the classroom. Play the tape to the group and have them guess what the objects are.
2. Find and bring back several objects which might be described in terms of density. Use an appropriate word to describe each, i.e., heavy, compact, porous, feathery, hollow, solid, wispy.
3. Find and bring back several objects that feel like they are different in temperature. They may feel different if they are wet, dry, powdery, sticky, fluffy, or of different materials or textures.
4. Find five things that taste (or smell) good. Don't experiment with mushrooms or berries, and don't swallow anything that doesn't taste good.
5. Find as many animals as you can with special adaptations, i.e., mouth for sucking or chewing, or legs for hopping. Bring back any you can (stream creatures may be easy to catch).
6. Find evidences of several food chains. Bring back what you can.
7. Find and bring back objects with different textures. Think of words to go with each object brought back.
8. With tape recorder, record sounds of two habitats and verbally describe them. (This activity carried over several seasons is very interesting.)
9. Find designs in nature. Make a stylized drawing of each design and bring back the object that inspired it.

Suggested readings:

Sybil Marshall, *An Experiment in Education,* Cambridge University Press (32 East 57th Street, New York, N.Y. 10022), 1966.

Joseph Featherstone, *Schools Where Children Learn,* Liveright, New York, 1971.

David Hawkins, "Messing About in Science," *Science and Children,* Vol. 2, No. 5 (February 1965). Reprints available.

Rachel Carson, *The Sense of Wonder,* Harper and Row, New York, 1965

Philip Morrison, "Experimenters in the Schoolroom," *Science,* Vol. 138, No. 3547 (December 21, 1962), pp. 1307-1310.

* These activity suggestions contributed by Leslie Clark, Education Director, Society for the Protection of New Hampshire Forests.

Some Suggestions

1. Take a trip to discover the unexpected world of little things. With a magnifying glass a patch of moss becomes a dense tropical jungle, a bit of pond weed conceals hordes of strange and wondrous beings, and every leaf, bud, or flower reveals unexpected beauty and complexity. Each child may take four feet of string to mark out his own study plot. How many different kinds of plants and animals can he find? What is the tallest plant, shortest? Draw a picture of some object of interest. Leave plots marked and follow up with return visits to see changes.

2. While on a walk, have the children collect a boxful of nature's odds and ends—rocks, pinecones, acorns, fallen leaves, feathers, etc. Let them find as many ways as possible to classify objects, i.e., can they be divided by roundness, weight, softness, roughness, symmetrical or non-symmetrical shape, being or having once been alive, some property that will change. (Classification is simply a way of "sorting" and unconventional ways should be encouraged.) Later, blind-folded, the children can take turns identifying the objects by touch.

3. Go on a walk to "feel." For safety simple paper bags over the children's heads will allow them to see the ground but still heighten their sense of touch. As a follow-up children might pantomime their physical reactions when they feel such things as icewater at the beach, sharp rocks with bare feet, snow getting in over their boots, a hurt knee, a soft puppy, a warm blanket on a cold night.

4. In some quiet, out-of-the-way place, have children close their eyes and listen for the sounds of nature—wind, rushing water, raindrops, insects, birds calling. Follow up with nature records in the classroom. The teacher or older children might use a tape recorder to make "mystery recordings," including the sounds of night. Then go out to listen again. For added excitement children might be blind-folded with other children to lead them.

5. Take a class on a "nosey" walk to see how many smells can be identified. Each child tells what event in his life various smells make him think of, i.e., smoke, fish, fresh-cut grass, hay, gasoline fumes, bacon cooking, tar, flowers, woods after a rain. He decides which he thinks is the nicest smell—and which the worst.

6. Everyone stretches out, eyes at grass level, to see what the world looks like to a bug. A weed is like a tree, while something as big as a tree may not even show. Follow this with a visit to a tower or steeple for a bird's eye biew. Big things look small, and the small may disappear entirely.

7. Use the school grounds to find "things that change." Snow and ice melt, rocks and sidewalks break down, soil washes away, plants grow in cracks, iron rusts, wood rots, tree buds open, flowers do too. Indeed, everything changes.

8. Have each child tell the first way he knew spring was coming, i.e., grass, birds, flowers, duck boards, children playing marbles, fathers taking off snow tires or putting away storm windows, farmer plowing, etc. Go out to look, smell, listen for signs of spring. Have each child keep a journal. Make measurements, i.e., the melting of a snow bank, the growth of a plant. Record daily changes at first, weekly later.

9. Have each child in the class adopt a tree for the spring. In late March or early April cut off one twig and bring it inside. Put it in water and observe. Make a drawing of a leaf scar ten times the natural size. Make a drawing of the general shape of the tree adopted. Compare shapes of various trees adopted by class members. Make bark rubbings. On the tree mark the base of a terminal bud with fingernail polish. Watch closely to see how much growth the bud adds to the twig after it opens. Make daily observations to watch for flower and leaf openings. Make various measurements, i.e., base of trunk, three feet up, diameter and length of lowest branch, distance to lowest branch. Can the height of a tree be found? How old might the tree be? Study shadows of the tree at different times of day. Which is longest? Shortest? What insects or animals live on or visit the tree?

10. Likewise adopt a wildflower. Insert a long stick beside the shoot and mark on it each day the date and height of the plant. Make graphs relating growth to temperature. Draw buds, flowers, leaves as they appear. Look for insects or animals. Record everything in a nature journal.

11. Find little climates, "micro-climates," on the school site. Take temperatures in such places as a tree hole, under a bush, on a sidewalk, on the grass, on both north and south foundations of the school building. Notice the difference between the living communities in each of these places.

12. Divide older class into teams, each with a piece of string six feet long. The string is used to stake out a claim. Each team should choose a different habitat—an open field, the edge of a woodland, deep woods, alongside a stream. Claims may be studied through the spring. Each team records for its claim such things as temperature on the ground, light level, wind, moisture of soil (can squeeze into a ball?), soil condition (with palm of hand see how far down can push pencil into soil), chief plant growing, any insect, bird, or other life seen. Means of calibrating can be devised and records kept.

13. Find some animal that can be kept for a few days, observed, and then released (earthworms, snails, red efts, polywogs, caterpillars, or other insects)—or one that can be reliably observed, as a bird that regularly visits a feeder. Get to know your new friend. For example, for a bird: what color is it, what shape is its bill, what and how does it eat and drink, does it walk or hop, what sounds does it make, does it make them while flying, does it soar like a glider, fly in a straight line or bounce up and down, when perched does it bob its tail, at what level does it put its nest, etc.

14. The forest floor provides an especially lively community for young children to discover. With magnifying glasses find out what the soil is made of. Identify particles from things that have been alive. What is living in the humus? Have the children observe and draw pictures of the living creatures. Each child may describe a creature for the class to draw. This may lead to concepts of "sorting," detailed studies of individual organisms like earthworms or some insect, questions involving food chains or webs, and even predator-prey relationships.

15. Look for shapes and patterns in nature. Find geometrical shapes, shapes that remind you of something, examples of symmetry (as in leaves), free and changing forms (as in clouds). Find patterns—in the bark of trees, in plants such as ferns, in birds, insects, etc. Look for numerical patterns—the number of leaves on a flower as related to the number of petals on the flower itself, the number of pine needles in a cluster.

16. Follow a stream ten minutes in each direction or either to its source or mouth. Younger children should explore with their senses, i.e., feel the temperature of the water, the plants in the water and moss-covered rocks, soil at the water's edge and on the stream bottom. They might speculate on where the water begins, where the mud in the water comes from, where the water goes when they can't see it any more. Follow up on any of these if possible.

17. On visiting a stream older children can map and take measurements of depth and temperature of the water, rate of stream flow (how long it takes a cork on a string to go ten feet), numbers and kinds of organisms in the water with different flow rates. Look for evidences of changes in the stream over time. Predict the path of the current and then check by muddying the water.

18. Observe the color and clarity of water in a stream or pond. What is living there? Have the children decide if the water looks polluted. What indicates this? Is anything floating in the water? What color is it? Does the water have an odor? Is this pollution?

19. Examples of flooding may easily be found in the spring. Have the children look for causes (including exposed and eroding surfaces above the stream) and effects on land flooded. Experiment to see which and under what conditions soils best absorb and hold water. Dams may be built on small streams to see how they affect stream flow, silt deposition, etc.

Prepared for New Hampshire-Tomorrow
by the Hanover Conservation Council
and the Regional Center for Educational Training

Sorting and Classifying – Session 2

Leader: course staff.

Part I - Introduction (5-10 minutes)

The last few years have seen publication of nature guides and field guides to almost any biological or geological subject of interest to the layman. These are very useful tools for help in identifying unknown objects and have an important place in learning and teaching even in the early grades. However, there is a tendency to take the scientific classification systems these utilize as something almost ordained and sacrosanct, something that shouldn't be challenged, let alone changed.

Actually, classification is a very natural thing. Man began long ago to use all his skills to help him make some sort of sense and order out of the vast number of things with which he was surrounded. Just as we do today, he began to compare objects and divide them into groups of things as they were related to him, and so to classify. Perhaps his first division was between things which would hurt him and things which would not, or things which could be eaten without getting a stomach ache and those which were not for eating. Later on, he began to classify things according to their relationship to each other, by size, or smoothness, or the way that they behaved, and in many other ways.

Like early man, all of us engage in the process of classification every day, although we do not call it by that any more than he did. As housewives we sort the laundry into heavily soiled, white, dark, synthetic, or permaprest. Outdoors we avoid poison ivy, bees, and wasps, but hunt wild raspberries or blueberries. In other words, we make small, useful patterns of the things with which we have to deal every day. We have built useful classification systems and rarely stop to think how much they help to keep our minds neat and tidy.

For most elementary-aged children the natural world is still pretty much unclassified, at least in adult terms, and the wondrous details of animal and plant structures are pretty much undiscovered. In working with children of this age, the important thing is not to impose names or labels on objects but to help <u>them</u> learn to organize information in ways that are useful to <u>them</u>. Help them to develop their own keys to the kingdoms. It is not necessary for you to know names of things. In fact, if a child is interested in something and you say, "Oh, that is a . . . ," he is most likely to reply, "Oh," and drop it. What is more important and useful is to encourage the child to investigate further—to observe carefully, to determine likes and differences, to discern relationships, and to organize his findings through a logical, systematic decision-making process. In time this will lead naturally into the use of prepared keys and more sophisticated scientific systems. And those official labels, so reassuring to adults, can be applied.

In today's class you are to go through the process of developing a simple classification key as might be useful to an elementary student. Try to forget what you know about formal scientific classification systems and take a fresh new look at the materials which have been provided.

Part II - Sorting and Classifying Exercise (1¼ hours)

Divide the students into groups of three or four members. Have for each group a small magnifying lens and an envelope containing paper of two colors cut as large and small circles and squares (see figure p. 22). Explain that they are going to learn to make and use a dichotomous key (di KOT' imus), meaning only two equal choices at any one point.

The choices are normally of the IS-IS NOT sort. Something IS red or it IS NOT red. In a key it is technically incorrect to say one thing IS red, versus another thing IS black. The choices in a key are numbered. Since there are two equal choices at each point of decision, these are given the same

number. For instance, if you are considering how to separate two different-colored pieces of paper, you might write the following:

1. paper red in color
1. paper not red in color

Each time you describe something, you should exclude all other possibilities. A key is usually set up in one of the two following forms (write on blackboard):

1. is _____ (2)
1. is not _____ (3)
2. is _____
2. is not _____
3. is _____
3. is not _____

1. is _____
2. is _____
2. is not _____

1. is not _____
3. is _____
3. is not _____

When a number is used twice, it should not be used again. In the first example, the number in parentheses after the choice tells you where to go next on the key.

Now ask each group to take the packet containing the colored paper cut into circles and squares. Tell them to look for one BIG difference between all these objects and physically divide the objects into two groups of roughly the same size based on this characteristic. This initial division might be by color, size, or shape. It should be stressed that any of these divisions would be correct. If the division was by color, someone might write down:

1. red (2)
1. not red

Next, work with one set of the objects (in this case the red) and leave the other set aside. Divide this set again into two parts, which are defined and become 2, 2, i.e.,

1. red (2)
1. not red
2. large (3)
2. not large

Again one subdivision is put aside and the other divided to make 3, 3, i.e.,

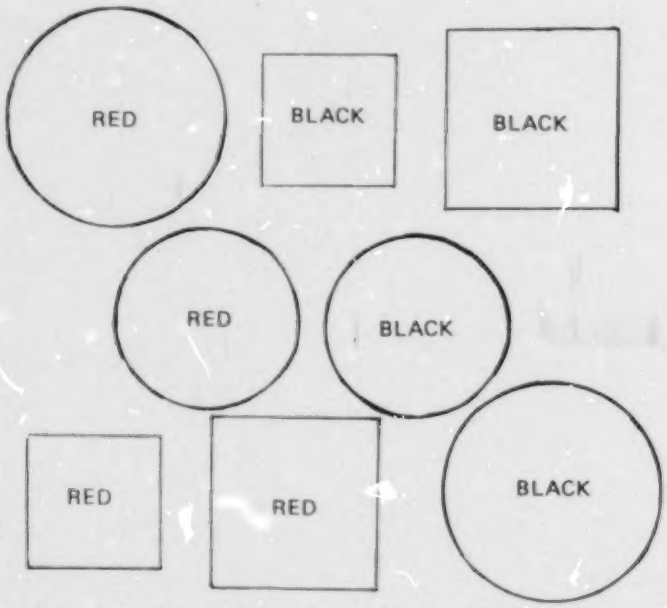
1 red (2)
1. not red
2. large (3)
2. not large (4)
3. square
3. circle

The small (remaining set) is then likewise divided:

4. square
4. circle

The same process is then repeated with the other grouping from the initial division. Since the next numbers to be used are 5, 5, this number should be added to the 1. not red (5). After all the separate items are divided out, names can be assigned if desired. A finished key for this set of objects might read as follows:

1. red (2)
1. not red (5)
2. large (3)
2. not large (4)
3. square — Nellie
3. circle — John
4. square — Mary
4. circle — Harry
5. large (6)
5. not large (7)
6. square — Sue
6. circle — Bill
7. square — Jean
7. circle — Bob



Have each group make another key for the same objects, until everyone feels comfortable with the key format. Then give each group a set of natural materials to key. Make sets with eight to twelve objects each, i.e., of shells, rocks, leaves, evergreens, seeds or seed-bearing objects, bones, twigs, ferns, or any assemblages or mixtures of readily available materials. The small magnifying lens will be helpful for each group in examining its objects.

Groups may make as many keys as there is time. Suggest that each member of the group physically write down at least one key to be sure she is clear on the format. Then about twenty minutes before the end of the session let each group try out a key developed by another group. The two groups should spend a few minutes afterwards discussing the usefulness of the key developed and/or any problems they found.

Part III - Conclusion (5 minutes)

Close by emphasizing the values inherent in the process of key making—the need for observing details and likes and differences, the difficulties of articulating these simply and clearly, and the requirement of a logical, step-by-step process. For homework have each student prepare a simple key out-of-doors, i.e., for leaves or ferns in some defined area. Also give each student a simple prepared key (see enclosed) to test by trying to identify one or two objects with it. Explain that there will be further opportunity to have help with using prepared keys during later field trip sessions.

Suggested readings:

Z. Subarsky, E.W. Reed, E.R. Landin, and B.G. Klaits, *Living Things in Field and Classroom*, Minnesota Mathematics and Science Teaching Project, University of Minnesota, 1967.

"Material Objects," Physical Science Sequence, Science Curriculum Improvement Study, Rand McNally and Co., Chicago, 1970.

"A Blocks" (No. 18481), Elementary Science Study, McGraw Hill, Manchester, Mo.

Differences in Living Things, Environmental Investigation Units No. 79025, National Wildlife Federation, Washington, D.C., 1971.

W.M. Harlow, *Trees of the Eastern and Central United States and Canada*, Dover Books, New York. Middle-level keys.

W.M. Harlow, *Fruit Key and Twig Key to Trees and Shrubs*, Dover Books, New York. Keys focus on eastern North America.

F.T. Parsons, *How to Know Ferns*, Dover Books, New York. Simple identification key.

Practice Key - Leaf Key to Trees of the Eastern United States

Leaves Needle-Like

1 Leaves needle-like or scale-like (2)
1 Leaves broad, not needle-like or scale-like (11)

2 Leaves in fascicles on dwarf branches (3)
2 Leaves solitary, not in fascicles (5)

3 Leaves evergreen, 2-5 in each fascicle (4)
3 Leaves deciduous, many in each fascicle, scattered on young twigs LARCH

4 Leaves in twos and threes YELLOW PINE
4 Leaves in fives WHITE PINE

5 Leaves opposite or in whorles of three (6)
5 Leaves not opposite or in whorles of three (7)

6 Leaves all opposite and scale-like, twigs flattened ARBOR VITAE
6 Leaves opposite or in whorles, scale-like, or awl-shaped on same tree, twigs not flattened RED CEDAR

7 Leaves four-sided, quadrangular SPRUCE
7 Leaves flat (8)

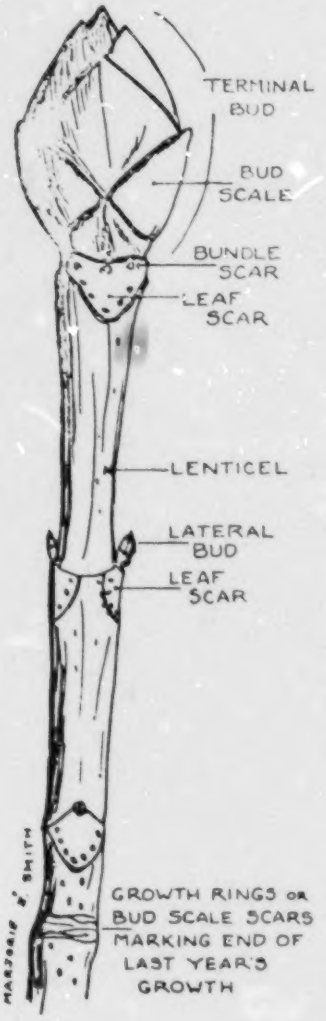
8 Leaves yellowish-green on both sides, appearing two-ranked or feather-like, deciduous twigs BALD CYPRESS
8 Leaves evergreen, dark green above (9)

9 Leaves with white lines beneath when young (10)
9 Leaves dark green above, yellowish-green beneath, usually 3-5 cm long YEW

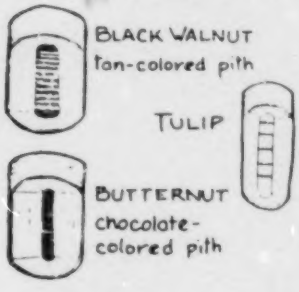
10 Leaves about 1 cm long with short petioles appearing two-ranked, cones 1-3 cm long, pendant (hanging down) HEMLOCK
10 Leaves usually 2-3 cm long, sessil, not appearing two-ranked, cones 5-10 cm long, erect FIR

HOW TO BE A TWIG DETECTIVE

HORSE CHESTNUT TWIG



SOME TWIGS WITH "CHAMBERED" PITH



Have you explored the miracle of buds? Observing eyes quickly find them, large and small, on bushes and trees in a variety of sizes, shapes, and colors. To identify buds it is important to notice their arrangement on the twig. Are they in pairs or **opposite** each other? A few trees have their buds so arranged — maple, ash, horse chestnut, and dogwood are native eastern ones. Most buds are **alternate**, appearing first on one side of the twig, then the other: elm, oak, birch, etc. Below the bud look for a **leaf scar**, left when the leaf fell off in autumn. It differs for each kind of tree. In the leaf scar are tiny dots or **bundle scars** which are the ends of veins that transported food and water between leaf and twig. These tiny dots may form a pattern, and even resemble a face in walnut and butternut.

Buds are usually protected by several scales. Willow is an exception and has a single, cap-like scale that covers the bud. This is easily seen in the pussy willow. Can you find the **terminal bud** of a twig when it has one? It is the largest bud at the very end, as in the maple. Buds along the sides of the twig are called **lateral buds.** Usually the larger buds contain flowers, or leaves and flowers, while the small ones are leaf buds. Open a large bud and look for these things.

When the terminal bud is formed, that ends growth for the season. Some trees do not have terminal buds. In these cases the twig keeps growing until food supply falls off. The twig then dies back to the last lateral bud, which becomes a pseudo-(false) terminal bud with a small round scar (different from the leaf scars) at its base where the branch died back and fell off. These buds are usually set at an angle (examples: linden, elm and sycamore).

Do you have little raised dots here and there along your twig? They are **lenticels** that allow oxygen into the branch (see "Word of the Month"). The dark lines on white birch bark are the lenticels.

A few inches from the tip of your twig you may discover several lines or rings close together. These **growth rings** were left when the bud scales of last year's terminal bud fell off. They show last year's growth or how much the twig grew in one year. Now look for the next ring further down. That marked the end of the twig two years ago. Starting at the tip of the twig, count the growth rings to get the age of the twig. Be a twig detective. Marjorie E. Smith

Small drawings by May T. Watts. Accompanying text adapted from her "WINTER TWIGS," a MORTON ARBORETUM BULLETIN.

SOME DISTINCTIVE LEAF SCARS

BLACK WALNUT
bundle-traces forming U-shape

BUTTERNUT
"velvet eye-brow" above leaf scar

CATALPA
bundle-traces forming circle

MAPLE
crescent scar with 3 traces

SYCAMORE
scar encircling bud

SUMAC
scar almost encircling bud

ASH
bundle traces form a line

SOME DISTINCTIVE BUDS

FLOWERING DOGWOOD
onion-shaped flower bud

BEECH
long, narrow bud

WILLOW
one-scaled bud

ALDER
smooth, stalked bud

OAK
clustered terminal buds

TULIP
"duck-bill" bud

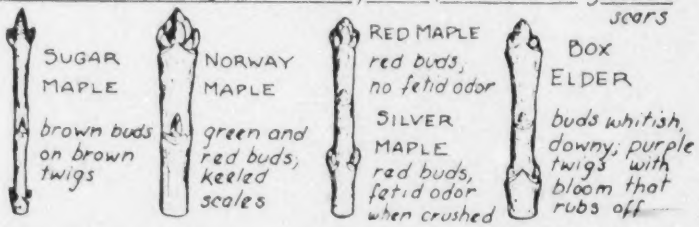
LINDEN
smooth, red, two-scaled bud

SOME CLUES FOR TWIG DETECTIVES

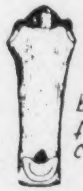
Curious Naturalist Supplement No. 6
Massachusetts Audubon Society
South Lincoln, Massachusetts

TREES WITH OPPOSITE BRANCHING

BUDS 1. Smooth buds, crescent-shaped leaf scars with 3 bundle scars


SUGAR MAPLE
brown buds on brown twigs
NORWAY MAPLE
green and red buds, keeled scales
RED MAPLE
red buds, no fetid odor
SILVER MAPLE
red buds, fetid odor when crushed
BOX ELDER
buds whitish, downy; purple twigs with bloom that rubs off

2. Rough, dry buds



3. Large terminal bud

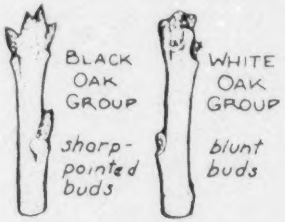
4. Onion-shaped flower bud

5. Often 3 buds at a node

TREES WITH ALTERNATE BRANCHING

BUDS 1. Single scale

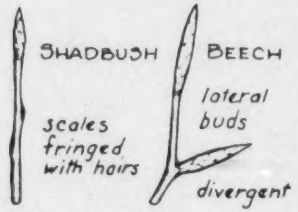
2. Clustered terminal buds



3. Large end bud with loose dark outer scales

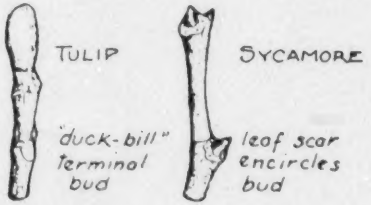
4. Flattened, yellowish buds

5. Long, narrow buds



TWIGS 1. Thick twig, thick pith

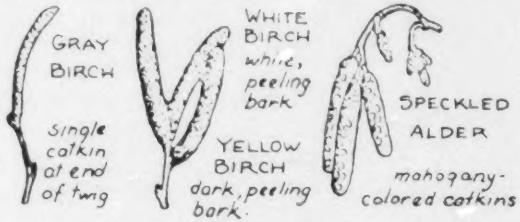
2. Line encircling twig at each node



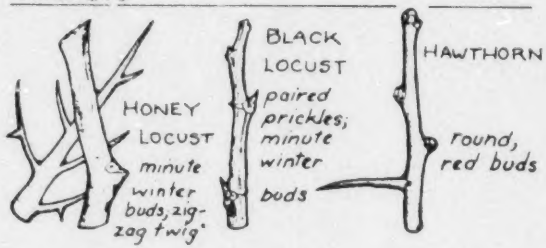
3. Knob-like twigs

4. Green twigs

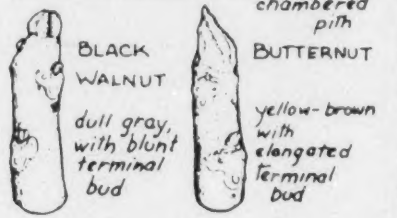
CATKINS in winter



THORNS



BUNDLE-SCAR U-shaped; chambered pith



Illustrations and text, from Winter Twigs, by May Theilgaard Watts, Bulletin of Morton Arboretum, Lisle, Ill. Used by permission.

Field and Forest Communities - Introduction to Ecology – Session 3

Leader: Someone working in botany, terrestrial ecology, or forestry. Good sources for leaders would be nearby high school or college teachers, the Society for the Protection of New Hampshire Forests, the U.S. Soil Conservation Service, forestry experts from state or county governments, or Resource Conservation and Development foresters.*

The purpose of this session is to give background in ecological principles, explain ecological communities, succession, climax communities, etc., as seen in the plant life of the local area.

Suggested readings:

Betty Flanders Thomson, *The Changing Face of New England,* The Macmillan Co., New York, 1958.
Shirley Miller, *The Story of Ecology for Audubon Juniors,* National Audubon Society, New York, 25 pp.
Ralph and Mildred Buchsbaum, *Basic Ecology,* The Boxwood Press, Pittsburgh, Pa., 1957.
Peter Farb, *Ecology,* Life Nature Library, Time-Life Books, New York, 1963.

Field Technique – Session 4

Leader: Any experienced field trip leader.

This session may be combined with any one or a number of the background field sessions. It may also be a separate session. The important thing is that somewhere in the course the field aides be exposed to useful advice on leading field trips and approaches for successfully involving children in field activities.

Tips for leading field trips

1. Know the area or trail. Visit the area in advance to gauge time needed and features of interest to your theme. Note potential problems (such as mud or high water) and prepare for them.
2. Have a specific purpose for your trip. Don't try to cover the whole trail every trip. Decide on the specific areas suitable for the theme or activities chosen (though of course you should be flexible enough to deviate in response to the children's observations or questions). If each trip has a new and specific purpose, an area may be used indefinitely without loss of the sense of wonder or discovery.
3. Have the children prepare ahead for proper clothes and equipment. This may require reminding.
4. Do not take out a group too large to handle in the activity chosen. Ten elementary children with an adult in a highly structured activity is probably a maximum. Four to seven children with an adult will be more realistic and successful. If there are two adults to help with a group, physically divide the group into two separate groups working in separate areas.

*See Appendix A for addresses.

5. In the field, don't lecture. Give simple explanations or background when needed, but for the most part encourage children to observe carefully and find out for themselves. Don't feel you must identify everything the children ask about. Instead ask questions, suggest activities. Have children make drawings or bring back samples of objects they want to identify for later investigation in the classroom.
6. Don't make the outdoor activity too long. A ten- to fifteen-minute field trip may often be enough for the youngest children. Forty-five minutes to an hour or more may be good for older elementary grades, according to the activity planned and the interest span of the group.
7. Keep the group under control, together, and however quiet the circumstances require. Otherwise the children will see and hear little. But, most of all, have a good time with the children. Share your own interest and excitement with what you discover, and they will feel it too.

Comments on field techniques by Ty Minton,* science teacher at the Putney School

I have the feeling that environmental studies often focus on one area: the polluted environment. My own personal feeling is that pollution is one thing that we're all concerned about and the cause of all the reaction nationally and in the colleges. My own feeling is that we have to get the students out in the field, to natural kinds of environment, and in a very real and personal way, so that they really come to love the environment unpolluted. And then from there, we can go to a study of the pollution that is occuring and how to prevent it. Because I think we really can't get them involved and concerned about pollution of the environment if they don't really care about it in the first place.

I think, in doing field work, we have to decide why we're going out there, what we're going to do when we get there, and what we want to happen. My own focus in field work, and especially with younger students, is that the most important thing we can do with them initially is to teach them to be good observers. Most of us are very sloppy observers: we just don't look at what we're looking at. And there are all kinds of devices to learn to do this, and there's no one best way.

The second thing is to personalize the experience, so that the out-of-doors really becomes a part of them. This is very hard to do, I know, with large classes. Field techniques for most teachers become a traffic-directing activity. With most teachers that I have worked with, we've been able to use volunteers, perhaps high school seniors, perhaps parents, perhaps school volunteers and aides. Then we can divide the class up into small groups and let each group go its own way. It's really terrific for our kids, for suddenly they see biology in a totally new context, and it breaks the class into a usable size.

The third thing—and I think this may not come initially in your first field experiences, but eventually—is to establish a basic understanding of ecological dynamics. My experience has been that pre-adolescent students have a very hard time dealing with generalized concepts. They're terribly excited about specific things, and if you concentrate enough on specifics until they are capable of dealing with concepts, then they can pull all of this previous experience together and really go somewhere. And I've become very frustrated working with teachers who are trying to deal with sophisticated ecological concepts too early. But that should be the direction you're aiming for. So the objectives as I see them are initially to (1) become good observers, and that very much underlined; and then, in doing that, (2) personalize the experience with them. So how do you do this?

*Excerpts from a speech given at the School Environmental Education Conference, Hanover, N.H., on December 8, 1969.

This fall I took my students to a spot in the woods, and I sat them down and I just said, "All right, go off on your own and spend ten or fifteen minutes looking at something that interests you, some biological thing. Don't take written notes, but make mental notes of the object you're observing, and then come back." And one student looked at me and said, "What if I don't find anything I'm interested in?" I said, "Well, go try." In ten minutes she came back absolutely hysterical about this thing she had found that she didn't even know existed. She'd never seen it; she didn't know what it was; and it was the most exciting thing she had ever seen. I could have turned this girl off very quickly with the wrong kind of approach, by testing, evaluating, pressured kinds of approach—but this worked.

Then I had them come back after their fifteen minutes and tell another person a list of observations, without telling what the thing was, and the other person would write it down. Then they reversed roles. The object here was, first of all, to get them by themselves, because, when they're in large groups, they don't see anything out in the woods. They're talking to each other, especially the young kids. They climb each other, hit each other, climb trees, throw things, but they don't look. And if you're going to get them to be good observers, you have to get them apart from the class.

And then I told the person taking the notes to guess what the object was at the end of the description. And then after they had done this, I had them come back together in a class, and I would take one list of observations and I would read it to the class and have the class draw the thing on pieces of paper from the description and show them to the class.

The first thing we did this with was a puffball. And the lists of observations were just very sad, and we came out with the most unbelievable pictures of things that were big and fat and round, and things that were tall and skinny with caps, and no caps and spots. And obviously the lists of observations were very inadequate. So I had the girl go back and get the puffball, look at it again, put it in her pocket, and come back to the group and give us a new list of observations and have the class draw the thing again. This time we came out with a beautiful set of pictures of puffballs.

Here each student was involved in a personal way, because he had to react to that one list by drawing something, even though we were in a group. I think this kind of thing is very important: they're involved physically with the thing, individually with the thing.

Of course, there are all sorts of other techniques which really are doing the same thing: for example, study plots that they put strings around. I was telling you about this particular student who didn't want to go out and look for something because she didn't think she could find anything interesting. I had her class set up sampling plots by giving each student one hundred feet of string and telling them to make the largest square they could out of that one hundred feet of string. The squares would be their study areas. This particular student fussed the whole way from the classroom to the field, saying this is totally ridiculous, it's uninteresting, she could care less about it. I happened to be there when she completed her square. Suddenly she was so possessive about that little square: "Don't you walk across my area! Get out of my area! You're stepping on those leaves over there!" Incredible change (I thought we should have been studying behavior rather than trees that day.)

It's a personalized thing. In giving each student a plot that belongs to him, he looks at it because it's his. It's a gimmick maybe, but it works. And of course there are all sorts of things that can be brought from the field into the classroom, but I try not to do this. My feeling is that classrooms are inhabited by people and cockroaches, and, if you want to study environment, you've got to get out of doors.

Suggested readings:

Charles E. Mohr, "How to Lead a Field Trip," Audubon Teaching Aids, National Audubon Society, New York, 1970.

Helen Ross Russell, "Ten-Minute Field Trips: A Teacher's Trial Edition for Use in the Primary Grades," Wave Hill Center for Environmental Studies, New York, 1970.

Field trip activities, prepared by Southeastern Pennsylvania Outdoor Education Center, Sycamore Mills Road, Media, Pa.

A Guide for Developing Nature Trails, Extension Folder No. 66, Cooperative Extension Service, University of New Hampshire, Durham, N.H., May 1968. Free.

Byron L. Ashbaugh, *Trail Planning and Layout,* National Audubon Society, New York, 1965.

Field and Forest Communities - Animals — Session 5

Leader: Someone working in zoology, terrestrial ecology, or land management. Good sources for leaders are the same as for Session 3, with the important addition of the state Fish and Game Department.

The purpose of this session is to better understand the role of animals in field and forest communities. It should deal with concepts of food chains or webs, predator-prey relationships, competition, niches, etc. The field work should emphasize animal signs, where to look and what to look for, and what children can do to find out more about the animals in their area, especially small mammals and common insects such as the white pine weevil. While trapping is not advised for younger children, aides might learn to make plaster track prints, set out smoked paper, and make nesting boxes. Study skins of small mammals found locally might be borrowed for the session from a nearby college or museum.

Suggested reading:

Information sheets put out by the Massachusetts Audubon Society, Lincoln, Mass.: "New England Mammals in Winter," " Some Information on How Animals Spend the Winter," "A Beginner's Alphabet of Winter Tracks and Signs," "Basic Grammar of Track Language," "Plaster Casting of Animal Tracks," "Skullduggery Among the Mammals or Food-Getting Adaptations."

Olaus Murie, *A Field Guide to Animal Tracks,* The Peterson Field Guide Series, Houghton Mifflin Co., Boston, 1954.

"New Hampshire Wildlife," N.H. Fish and Game Department, Concord, N.H. Free folder.

Helenette Silver, *A History of New Hampshire Game and Furbearers,* N.H. Fish and Game Department, Concord, N.H., 1957.

Ellsworth Yeager, *Tracks and Trailcraft,* Macmillan Co., New York, 1948.

Oaks, Acorns, Climate and Squirrels, Environmental Investigation Units No. 79089, National Wildlife Federation, Washington, D.C., 1972.

ANIMAL TRACES ON SMOKED PAPER

MATERIALS NEEDED:

white shelf paper - waxed on one side
kerosene lamp - may be made by putting hole in lid of small jar and inserting rope through the hole for a wick
aluminum foil
bait - oatmeal, peanut butter, nuts, raisins, etc. It would make a good experiment to try different kinds of bait to see what might be attracted.
can of spray lacquer or clear acrylic

TO SMOKE PAPER:

The waxed side of shelf paper should be held taut (may be attached to 2 yard sticks or around a large can) close over the flame of a kerosene lamp. Move constantly to avoid catching on fire and until the area is evenly coated with soot.

Tape smoked paper to inside of a box for carrying to the study site.

STUDY SITES:

Good study areas are (1) those that show some evidences of animal activity, i.e. "runs" through the grass, burrows in the ground, shredded pine cones or nuts, scats, and tracks; and (2) areas next to logs or fallen branches that might make natural pathways.

For best results, pick a likely spot and leave out bait for 2 or 3 days before setting up smoked paper.

TO SET UP SMOKED PAPER:

Put smoked paper in selected site with stick pegs at each corner to hold down securely. A canopy of aluminum foil should be made to keep dew from ruining the print. This may be held in place in any way practical for the spot, i.e. tied to overhanging bush or supported like a lean-to by sticks stuck securely in the ground.

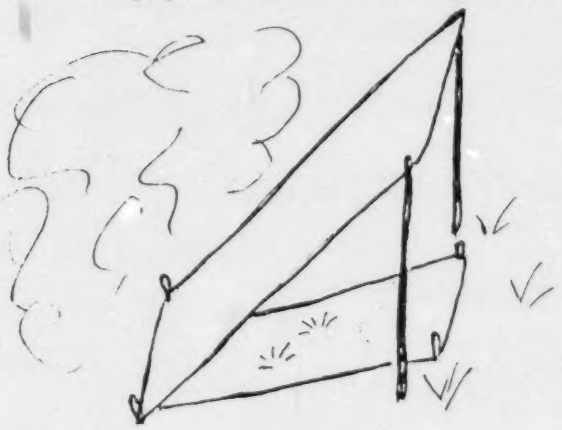
Bait may be placed on the paper or just beyond it where animals must cross to reach it.

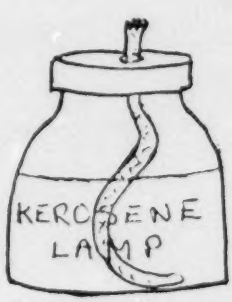
TO PRESERVE PRINTS OBTAINED:

Spray on the spot with can of spray lacquer. As soon as it dries, it can be stacked or carried without danger of smudging.

TO INTERPRET PRINTS:

Tracks may be identified by any of the many standard guides to tracks. In addition to tracks, look for marks made by mammals' body fur, tails, and whiskers. Very tiny trails and those showing no evidence of fur are often made by insects. Thick, squiggly trails are often made by slugs and snails. Children could experiment by releasing trapped slugs, insects, frogs or toads, and pet animals to walk across smoked paper. Note that if bait is placed on the paper, sometimes tongue licking may obliterate all marks in that area.





Ecology and Curriculum – Session 6

Part I - Eco-System Model (45 minutes)

Students should be provided with worksheets (see model p. 30) and divided into groups of five. If possible each group should be provided with a small model eco-system. However, there should be at least one easily viewable model system,* consisting of such things as a large predator (i.e., hawk or owl), a small insect-eating predator, insect, green plant, fungus, rock (preferably with lichen or moss growing on it), and dirt or sand. Water may be added if desired. Explain that each part of the eco-system model should be considered a symbol of many species and communities. Thus the green plant represents annuals, perennials, shrubs, trees, forests, grasses, algae, i.e., all plants.

Start by having the group name four or five examples of each of the plant, animal, and abiotic components of the eco-system. This may call for a brief discussion of the meaning of "abiotic."** Then ask each member of the group to concentrate on one of the five relationships shown on the diagram on the worksheet. Each person is to spend about ten minutes trying to list all the examples of this relationship she can think of. When individual efforts are finished, the group is encouraged to spend fifteen to twenty minutes in a discussion of each relationship. As a result of this collaboration, each group should come up with its own list for each of the five relationships. The ultimate extension of this effort could be a compilation of the group lists into a master list by the entire class. If not included by the students, the following relationships should be suggested by the session leader: food, moisture, shelter, protection, support, shade, temperature modification, decomposition, composition of air or water, etc.

Part II - Demonstration or Discussion of Curriculum Applications (45 minutes)

Demonstration or discussion of how ecology might be brought into elementary curriculum can be carried out in any of several ways.

A teacher might describe a program or even a single activity used to help children discover ecological relationships. Especially appropriate would be a description of the SCIS Life Sciences Program (see bibliography). In this ecologically-oriented program children build, observe, and manipulate simple eco-systems by means of terraria and aquaria. At the Grade 1 level they focus on organisms, Grade 2 - life cycles, Grade 3 - populations, Grade 4 - environments, Grade 5 - communities, and Grade 6 - eco-systems.

The objectives of this session might also be met by a short walk around the school grounds with an experienced teacher who could help the group discover examples of ecological relationships right in the school yard. Another way of stimulating observation and discussion is to have each student find (1) two objects that are interacting, (2) two objects that are related to each other in some way, or (3) an object which is changing. Each student could then point out her discovery and suggest an activity to further investigate her observation.

Useful curricular materials:

Environmental Investigation Units prepared by the Environmental Science Center of the Minnesota Environmental Sciences Foundation, Inc., and published by the National Wildlife Federation, Washington, D.C., 1971-72.

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*This exercise can be done with pictures as stimulators, but the presence of <u>real objects</u> adds immeasurably to the interest generated in the class. Stuffed animals or study skins can usually be borrowed from a museum or college collection.

**Abiotic: not living or caused by living organisms.

Life Science Sequence of the Science Curriculum Improvement Study (SCIS), published by Rand McNally and Co., Chicagc, 1970.

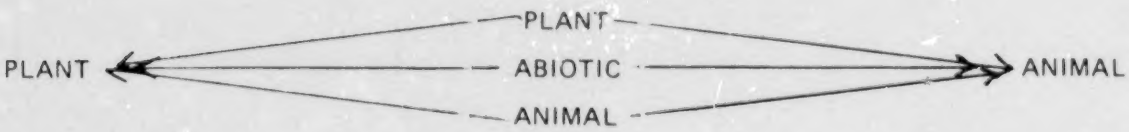
Elementary Science Study, McGraw Hill, Manchester, Mo.

Activities described in *Science and Children*, periodical put out by National Science Teachers Assn., Washington, D.C.

Audubon Junior Program, units on mammals, plants and flowers, trees, birds, and ecology, National Audubon Society, 1130 Fifth Avenue, New York, N.Y.

William B. Stapp, *Integrating Conservation and Outdoor Education into the Curriculum – K-12*, Burgess, Minneapolis, 1965.

Katherine Wensberg, *Experiences with Living Things: An Introduction to Ecology*, Beacon Press, Boston, 1966.



PLANT – PLANT

PLANT – ANIMAL

PLANT – ABIOTIC

ANIMAL – ANIMAL

ANIMAL – ABIOTIC

Plot Study

What is it? Study of a selected small plot of ground either by an individual student or by a small group of students.

Purpose of study: This can vary greatly according to the grade level and curriculum objectives to be served. For example, study may focus on any or some combination of the following:

1. Individual organisms, adaptations, producers, consumers
2. Life cycles, seasonal changes
3. Populations, food webs, niches
4. Effects of environmental factors (i.e., temperature, moisture) on individual organisms or populations
5. Communities of populations, dynamics re: relationships among populations and in response to environmental factors
6. Eco-systems, hydrologic and other cycles, succession

Also, the process of making any of these studies involves students naturally in good basic approaches to scientific investigation—observing, gathering, and organizing data into useful forms, hypothesizing, testing, etc.

Usefulness of approach: Students have frequently become very possessive about "their" plots. This personalization can create great interest and encourage closer observation than otherwise likely. Systematic study focused on even a small plot of land can answer many questions. Further opportunities are opened by comparisons of plots in different habitats or with different environmental conditions.

Sixth Grade Plot Study

Each plot measures approximately two meters by two meters. The following are observed and described: (Note these may lead into classification, ways of measuring or calibrating observations, use or making of simple equipment, etc.).

1. Environmental factors
   Temperature - 2 cm below ground, ground surface, one meter in air
   Light
   Wind
   Moisture
2. Soil
   Physical characteristics, profile, color, texture, moisture
   Life present
3. Detritus
   Composition
   Depth
   Life present
4. Plant life
   What found, description (i.e., height of tree, kinds of leaves, flowers, etc.)
   Numbers of each population - using representative sampling if appropriate
   Animals present on plant life
   Observed relationships: plant-plant, plant-animal, plant-abiotic
5. Animal life (other than in soil)
   Description
   Relationships: animal-animal, animal-plant, animal-abiotic

ECOLOGICAL STUDY MIGHT BE BASED ON THIS CHART.

BIRD STUDY *Bills, Feet, Tails and Wings reveal many bird habits —*

they are wonderful examples of nature's amazing ingenuity in solving the problems of survival.

Hairy Woodpecker

Drawings by Walter Ferguson

FOR EXAMPLE:

the WOODPECKER'S strong, chisel-shaped bill is adapted for chipping wood as a means of boring into trees in search of grubs. Its feet have two sharp toes directed forward and two backward which clamp the bird securely to the tree trunk in an erect position. Sharp-pointed tail feathers act as props to steady the woodpecker while it uses its bill as a hammer.

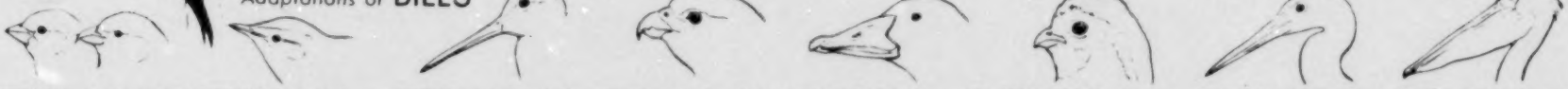
BILLS of birds are variously adapted for procuring different foods and serve also for nest building, preening feathers and for protection.

FEET are built for perching, scratching, walking, swimming, for seizing prey.

WING size and shape vary greatly. Some wings are designed for soaring, for sudden turns and rapid flight, for easy long distance travel.

TAILS provide balance when perching and flying, are rudders during flight.

Adaptations of BILLS



SEED EATING—(a) short, thick bill for crushing seeds. *Examples:* Sparrow, Grosbeak, Bunting,—Finch *(shown)*

(b) upper and lower mandibles crossed to enable bird to extract seeds from cones of evergreen trees. *Example:* Crossbill *(shown)*

INSECT EATING — (a) slender, pointed beak for picking up insects. *Examples:* Warbler, Vireo *(shown)*

(b) very wide mouth for catching insects on the wing. *Examples:* Swallow, Nighthawk, Swift

PROBING—(a) long, slender bill for probing in mud in search of food. *Examples:* Snipe *(shown)*, Woodcock, other Sandpipers

(b) long, slender bill for probing the necks of flowers to feed on nectar. *Example:* Hummingbird

PREYING—strong, sharp, hooked bill for tearing flesh of prey. *Examples:* Owl, Hawk, — Falcon *(shown)*

STRAINING—broad, flattened bill for straining food from mud. *Examples:* Flamingo, Duck,—Goose *(shown)*

GROUND FEEDING — short, stout bill for feeding on the ground, as a hen. *Example:* Bob White *(shown)*

FISH EATING—(a) long and sharp for spearing fish. *Example:* Heron *(shown)*

(b) with a flexible pouch under neath bill for holding captured fish. *Example:* Pelican *(shown)*

Adaptations of WINGS

Long, pointed wings for fast, easy flight in the pursuit of flying insects. *Examples:* Swallow,—Swift *(shown)*

Long, broad wings for strong, soaring, effortless flight. *Examples:* Hawk *(shown)*, Eagle

Short, rounded wings for speedy take off and fast flight over comparatively short distances. *Examples:* Sparrow, Quail,— Pheasant *(shown)*, Woodcock, Grouse

Adaptations of TAILS

Tail feathers with strong, spine like tips for use as a prop or support when clinging to vertical surfaces. *Examples:* Woodpecker, Swift,—Brown Creeper *(shown)*

Broad, fanned tail for soaring. *Example:* Buteo type Hawk *(shown)*

Long, forked tail for graceful, skimming flight and extreme maneuverability. *Examples:* Tern,—Barn Swallow *(shown)*, Frigate Bird, Swallow-Tailed Kite

Adaptations of FEET

PERCHING—three toes in front, one toe behind. Most familiar birds are of this type. The foot automatically clasps the perch when the leg is relaxed. *Examples:* Sparrow, Chickadee,—Robin *(shown)*

WADING—long legs, long, slender toes. The three long toes keep bird from sinking into the mud. *Examples:* Gallinule, Heron,—Sandpiper *(shown)*

PREYING—powerful feet and legs with strong, curved, sharp talons for grasping prey. *Examples:* Hawk, Owl,—Eagle *(shown)*

SWIMMING—three front toes fully webbed. *Examples:* Goose, Gull,—Duck *(shown)*

CLIMBING—two toes in front, two toes in back, sharp claws for clinging to an upright surface with ease. *Example:* Woodpecker *(shown)*

SCRATCHING — claws strong and blunt for raking or scratching the ground for food, as a hen. *Examples:* Pheasant, Quail,—Grouse *(shown)*

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The Audubon Nature Bulletin, **BIRDS — How Birds Are Adapted For Existence**, 4 pp. illus. is recommended for use with this chart on Bird Study. 20 cents per copy.

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Pond and Stream Communities – Session 7

Leader: Someone working in the field of fresh water biology (limnology) or aquatic ecology. Schools and colleges are obvious sources, but people with such training are also found in Fish and Game Departments, the U.S. Soil Conservation Service, and governmental groups concerned with water quality control.

This session should bring together the various ecological concepts introduced in earlier sessions by giving a total look at easily distinguished ecological communities. A pond or a stream or both may be chosen. A longer time period, three to four hours, may be required if visits are made to both types of communities.

Pond study should include life cycle of pond systems; physical characteristics; living organisms; and interrelationships of water depth and surface, oxygen content, temperature, nutrients, and populations of algae, zooplankton, bacteria, etc. The pond beautifully demonstrates the complexity, interdependencies, and fragility of an ecological community. Likewise, stream study will emphasize plants and nutrients, where they come from, where animal life can be found, and relationships to environmental factors such as light, siltation, and rate of stream flow.

Aides should have experience in making measurements for oxygen, temperature, turbidity, rate of flow, etc.; in collecting plankton and other organisms; and in using microscopes and keys to identify their findings.

Suggested readings and references:

William H. Amos, *Limnology*, LaMotte Chemical Products Co., Chestertown, Md., 1969. Excellent, inexpensive (50 cents) booklet.

J.G. Needham and P.R. Needham, *A Guide to the Study of Fresh Water Biology*, Holden-Day, Inc., San Francisco, 1962. Keys and pictures - complete.

George K. Reid, *Pond Life*, A Golden Nature Guide, Western Publishing Co., New York, 1967. Good field reference for use with children.

E.B. Klots, *The New Field Book of Freshwater Life*, G.P. Putnam's Sons, New York, 1966.

William H. Amos, *The Life of the Pond*, Our Living World of Nature, McGraw Hill, New York, 1967.

A Curriculum Activities Guide to Water Pollution and Environmental Studies, Tilton School Water Pollution Program, Tilton, N.H., 1970.

Field trip activities prepared by Southeastern Pennsylvania Outdoor Education Center, Media, Pa.

The Pond

The following questions taken from materials developed by the Southeastern Pennsylvania Outdoor Education Center might be helpful in initiating study of a pond.

I
What is a pond?
Why is the pond here?
Will it always be a pond?

How is the pond area different from the nearby field?
How does a true pond differ from a flooded area made by a bad storm the day before?

Where is the water coming from?
Where is the water going? Is any water going out that you don't see?
Does the amount going out equal the amount coming in? How can you tell?
Why do you think this is the case? When might the amount going out exceed the amount coming in?

Observe the surface, shores, and bottom, and any stream or sign that water has entered. What else is coming into the pond besides water?
How are these things coming in?
Where are they coming from? Where will they go?

Are there signs of soil that has washed into the pond? Where is this located? Why?
What becomes of the leaves and other plant materials that enter the pond? Why?
Is this material—soil and plant materials—beneficial or harmful to the pond and its life? Why?
What changes will the invaders make in the pond over a period of time?
Will these changes be good or bad? Why do you think this?
Could man prevent these changes?
Would it be desirable to do so? Why do you think this? From whose point of view are you answering?

Do you see any indications that the shoreline is changing? Describe what you see and what you think is happening.
What plants are growing along the shore? Where are their roots? What will become of the seeds from these plants if they fall into the water?
Will these plants continue to grow here? Will their numbers increase? Why do you think this?
How do you think different ones of these plants will change the pond environment? Will these changes be good or bad? From whose point of view?

What seeds have fallen into the water other than those from plants at the water's edge? Where did these seeds come from? Will plants grow from these seeds? Where? Why do you think this?

What color is the water? Is it clear?
Is there anything floating in it? (If so, describe it.)
Do you think that it would be good to drink? Good or bad to taste? Good for health? Good for something else?
Do you think this water is polluted? What does "polluted" mean? Why do you think this?
What other things are in the water? Might there be other things in it which you can't see? How could you find out?

II
What animals do you expect to find at the pond? Do you expect to find them in the water?
Do you see anything living in the pond? What size is it? What does it look like? What colors do you see?

Do you see any animals in or around the pond that use the water in a way similar to the way man uses it?
Water strider, frog—skating, swimming motions
Birds, forest or water animals—drink it and get food from it
What kind of food would man get from the pond?

What daily activities must the pond animals carry on that man also must carry on?
Eat and drink
Breathe
Activity—rest
Excrete
Others?
What are some of the things which an organism would have to be able to do to survive in the pond?

What changes would have to be made if you were to live in the pond?
What things do all organisms living in the pond have in common?

What do the pond animals eat?
Do they need air? How do we know the animals use air?
How can we find out about the activities of pond animals?

What would happen to the pond life if the pond became dry?
How could the pond become dry?
How might the area change if the pond disappeared?
If this pond does eventually disappear, what will become of all the animals that live in the water? Why do you think this?
Will this happen all at once?

Would you expect to find the same things living in all parts of the pond? Why?
What are the parts of this pond? Investigate each—or divide up into groups with one group responsible for each of these pond habitats.

1. Bottom: mud and decaying vegetation
2. Shallow water near shore
3. Deeper water
4. Surface
5. Air over pond
6. Shore

After inspection of each habitat and collection of specimens for each as possible, the following questions might be asked:
Was anything living in the mud and leaves on the bottom of the pond? What?
What did you find in the shallow water? What did you find in the deeper water? Did you see anything you couldn't collect?
What was on the surface?
What did you see in the air over the pond?
What did you find along the shore?
Did you find the same things living in each part of the pond?
What reasons can you give for this?
What are some of the things that make each of these habitats different?

III
Reinvestigate the habitat previously investigated.
How deep is the water?
What is the temperature of the water in this area? Air?
How much light does it receive compared to the other area?
What food seems to be available?
Is oxygen available to animals that breathe with lungs? With gills?
What is the color of the water at this place? Why might this be?
How much cover (protection from enemies) is available?
What are the factors that seem to make this part of the pond the way it is?

Observe again the organisms collected.
What would these animals probably eat?
How would these animals get a supply of oxygen?
How are the organisms collected or observed adapted to living in the part of the pond where you found them?

In what parts of the pond would they not be able to live? Why?
Could they live away from the pond?
Which habitat seems to have the most organisms?
How are the organisms in each of the pond habitats dependent on the other habitats of this pond?
Which would be affected first if the pond were drained? Why?

The following specific questions might be asked in regard to organisms found:

Fish

How does a fish swim? What part of its body does it move? Does it move its whole body?
How does a fish "stand still" in the water?
Can a fish see you on the shore? How?
How does a fish get air? Why do you say this?
How does a fish's body illustrate streamlining?
How has man copied the fish?

Frog

How does a frog get air?
How does the skin of a frog differ from the "skin" of a fish?
How do the eyes of a frog differ from the eyes of a fish?
Do you think the frog sees you coming or does he hear you? Why do you think this? How could you find out for sure?
Why can a frog jump so well?
How is a frog adapted to life on land as well as in the water?
How does a frog eat? What does he eat? Does he get his food in water, on land, or in the air? What did you observe that gave you this idea?
What are the frog's adaptations for swimming?
Do you swim more like a frog or a fish? Why?
Has man copied the frog in any way? How?

Tadpole

How does the tadpole swim?
How does this compare with how the frog swims? The fish?
How does the tadpole get air? Compared with the frog? The fish?
What does the tadpole eat? Did you observe them eating?
How does this compare with what the frog eats? The fish? If you don't know, how can you find out?
Why do you suppose tadpoles are found in such large groups in the shallow water? Will they always stay there? Why do you think this?
How will the tadpole have to change to become a frog?
How is the tadpole like a fish? Unlike a fish?
Is the tadpole more like a fish or a frog? Why do you say this?

Insects water strider, diving beetle, whirligig beetle, water boatman, back swimmer, etc.

How does the _____ stay on the surface of the water? Does he?
How does he move from place to place? Would you say he swims?
How does he get air when he goes underwater?
Could these insects live away from water? How could you find out?
What do you think becomes of these insects during winter? How could you find out?
Has man designed anything which copies this insect?

Insects - mosquito larvae, dragonfly larvae, damselfly larvae, etc.
How does this insect breathe? What do you observe that makes you think this?
How does it move? Would you say it swims?
Could it live away from water?
Has man designed anything which copies this insect?

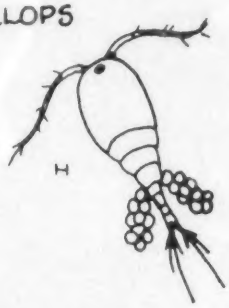
Which of these animals would you like to know more about?

Does man depend on this pond? List all of the ways you think ponds are important to man.

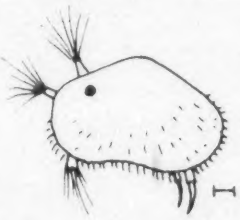
SOME POND CREATURES AND THEIR SIZES

CRUSTACEANS

CYCLOPS



OSTRACOD



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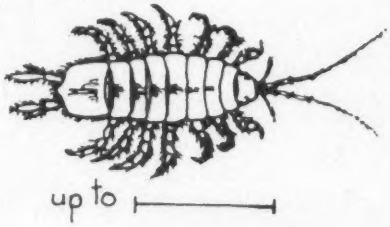

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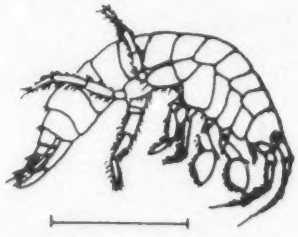
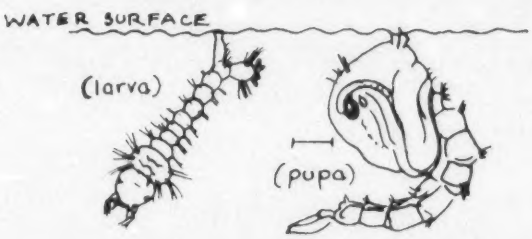
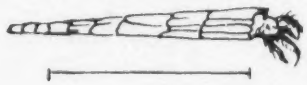


INSECTS

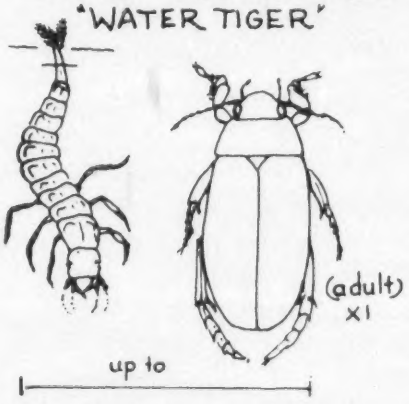
MOSQUITO *



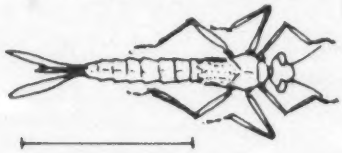
CADDISFLY LARVA IN CASE



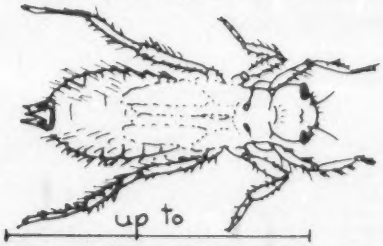
DIVING BEETLE LARVA or "WATER TIGER"



DAMSELFLY NYMPH



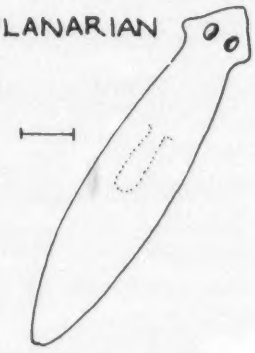
DRAGONFLY NYMPH



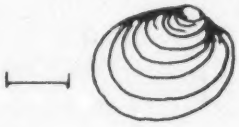
OTHER

WATER MITE

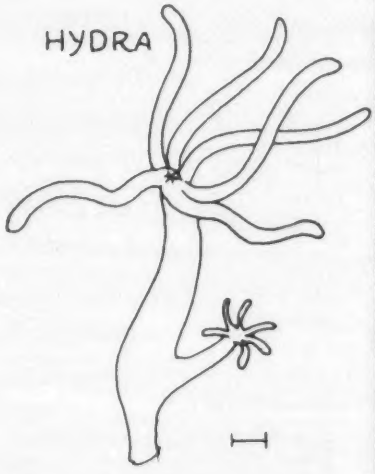
PLANARIAN



"PILL CLAM"



HYDRA



* NOT FOUND IN WINTER

M33

Compass and Mapping Skills – Session 8

The purpose of this session is to make the aide more comfortable about using compass and various types of maps in working with children out-of-doors. If the Hanover experience holds true, many young women have never held a compass and find topographical maps a complete mystery. It seems best, therefore, to assume no prior experience and to have the aides learn by actually going through activities that might be used in introducing these skills to children.

Exercise I (1 hour)

Divide the class into groups of five or six each. Have available on a table enough equipment for each group to have at least one or two compasses, eight to ten golf tees, and some measuring device (meter or yard sticks, tape, string marked at one-foot intervals, etc.). Before the groups take their equipment, ask what they notice about the compasses—that all of the compass needles point in the same direction. You can explain that the north end of the magnetic needle of a compass always points to the magnetic North Pole.

Each group should have an instructor who has previously gone through the exercise in a training session and can show her small group how to orient the compass and use it in the game to follow. The instructor will take her group to any relatively flat area, roughly 25 feet in diameter, which does not overlap the area of another team.

The first step is to have each member of the group hold a compass level in her hand and then slowly turn around in a circle, always observing what direction the needle points. Be sure that everyone is convinced that (1) the needle of a compass always points in the same direction, and (2) the needles of all compasses point in the same direction. If a compass is off, see if something is deflecting it (as may happen inside a building or near certain metals), or if perhaps the needle has been demagnetized and damaged (as may happen if a number of compasses are stacked on top of each other).

Next show the group how to orient the compass, turning it until the magnetic needle is parallel with the orienting arrow (N-S arrow) in the compass housing. Now the north end of the needle and the orienting arrow should point in the same direction. Have the group notice how the dial is marked off into 360 units or degrees, but suggest that when beginning with children it is better to use the simpler major divisions of N, NE, E, SE, S, SW, W, and NW.

When the group seems ready, the instructor can start the game. Each team is to lay out a course using the compass and with the golf tees as markers. Then each will swap with another team who must be able to follow the directions given to recover the markers. The object is to give such accurate directions that the other team will succeed.

Select a starting point, place tee 1 there, and write down where it is. Each member of the team will be responsible for placing one tee. However, everyone should have a job in the placing of each tee—using the compass, being the marker, helping measure, giving a second check to direction or distance, or writing down the instructions. Have the first team member place the compass directly on the starting tee (more stable and accurate than in the hand), and turn it until it is oriented (the magnetic needle and orienting needle pointing in the same direction—N). The person should choose what direction she wants her tee to be placed, keeping to the major compass directions, i.e., E or SE. If the compass has a direction arrow on a transparent plate underneath, this can be turned in the direction desired. If not, it is helpful to use a pencil on the ground as a pointer. It is recommended that another team member go in the indicated direction to serve as a sighting point. Then some distance can be selected along the line from the starting tee to that person for placing the tee. Warn the group that children will often

want to push the tee so far into the ground that it will never be seen again, or put something over it to hide it. Carefully explain that they want the competing team to be able to find their tees, though of course it is more fun if the tees are not too obvious. Also choose simple measuring units to lessen chances for error, i.e., three or four measuring stick lengths; and don't choose distances longer than fifteen to eighteen feet, because small measuring errors will be compounded. Place the tee and write down the instructions, i.e., Tee 2, go E for four measuring units (or yardstick lengths).

Now starting at the tee just placed, a second member of the group will take her turn to use the compass to place the next tee in the same way. The direction and distance will be recorded and so on until each team member has used the compass to place a tee and a course of six or seven tees has been laid out.

Finally teams will pair up and swap instructions and measuring devices. If a team cannot follow the course as described, it should challenge the group that laid out the course. Winning teams are those which successfully laid out a course and described it accurately.

Discussion (15 minutes)

After the compass exercise it will probably be helpful to the aides to have an experienced teacher outline the total program (into which these exercises fit) for teaching mapping and use of the compass.

For example, the first step might consist of mapping the top of a table with a number of items on it or of mapping the classroom. Such exercises will indicate the usefulness of (1) working out some way to show scale and relative size; (2) having some clear way to indicate direction; (3) using symbols on the map rather than drawing each item; and (4) making a key to interpret the meaning of the symbols used.

The class might then go through the exercise to learn to use the compass. As a follow-up the children can draw a map showing the course plotted by their team. They will find it necessary to show the starting point relative to some landmark, indicate the direction of north on their map, and work out a distance scale.

The teacher might follow this with various activities in which children practice mapping various areas. One activity is to have a group of children mapping each of the four quarters of the classroom. When the four quarters are taped together, the resulting map is usually a convincing argument for consistent and standard means of indicating scale, direction, perspective, etc.

The teacher will also have the children work with available maps of various kinds. Using a map of the local area, the children might compare their own compass readings with directions indicated by the map. This can be done in a walk out from the school, preferably to some elevated spot—a hilltop or tower—from which various landmarks are visible. The children also might take a school bus trip around the town, comparing the map to what they see.

If the terrain is at all rolling or hilly, the children will raise questions as to what to do about this on maps. The following exercise to introduce the concept of topographical mapping is very simple and effective.

Exercise II (45 minutes)

Divide the class into groups of four to six. Obtain a number of clear plastic shoe boxes, with transparent lids if possible. If such lids are not available, pieces of clear, heavy plastic material can be taped

on as a substitute. Provide each group with a plastic box, a rock that will fit into the box, a ruler, masking tape, one waterproof magic marker, one water soluble marking pen, and a container for water. Well-chosen rocks are important to the success of this exercise. Whether rounded or angular, rocks should have at least one gently sloping side and one fairly steep side.

Have each group place a strip of masking tape vertically on the outside of the plastic box, and mark the tape every one-half inch from the bottom to the top of the box. A piece of white paper placed under the box will improve contrast. Each group should place its rock in the plastic box and carefully pour in water to a depth of one inch. Taking the waterproof magic marker, one member of the group should draw a line around the rock at the water level. For greater ease, the rock may be lifted out of the water. It will be wet to the level inundated and can be easily marked. The resulting mark is known as a contour line. Suggest that this contour line be considered sea level, and that each inch above this will represent a rise of one thousand feet. Just where those contour lines will be can quickly be determined by progressively adding one inch of water and marking the water levels on the rock. The end result will be a rock showing contour lines at one-inch intervals, each representing one thousand feet rise in height. A child might think of it as if the sea had risen in one thousand-foot stages until it covered the rock mountain.

The group should empty the water for the next activity. The same or another rock should be placed in the container. Again water is added to a depth of one inch, or "sea level," but this time the transparent lid is put on. A member of the group should look through the lid from directly above. Using the water soluble pen (to allow later cleaning),* he or she can trace directly on the lid the outline of the water on the rock. Someone can add another one-half inch or one inch of water and again draw the outline onto the lid. This is continued at whatever interval chosen until the contour lines of the rock at one-half inch or one inch vertical rises have been transferred to the flat surface of the lid of the box. The result is a simple topographical map.

Compare the topographical map with the model. How can one tell where the hill is steep? Where is the slope gentle? Observing the contour lines, ask, "If you are feeling lazy, which way would you want to take up the hill?" Or, "If you are an adventurous mountain climber, which route would you choose?"

With children the exercise might be continued, using different-shaped rocks or clay models of land forms. They will soon associate contour map patterns with the land forms they represent.

Suggested references:

Stuart E. Bell, "Scale Drawing and Surveying," in collaboration with the School Mathematics Project, published by Longmans, Green & Co., Ltd., 48 Grosvenor Street, London, W1, England.

"Making Maps" and "Outdoor Mapping," Elementary Science Study of Education Development Center, Inc., 55 Chapel Street, Newton, Mass.

Clifford E. Knapp, "The Slope of the Land," *Science and Children*, March 1969, pp. 14-15.

*Or, if preferred, clear plastic or acetate film can be attached to the lid and regular waterproof marking pens used.

Geological History of Region – Session 9

Leader: Someone working in the field of geology. In addition to schools and colleges, sources for leaders may be mining companies, highway departments, the U.S. Army Corps of Engineers, and the U.S. Soil Conservation Service.

This class will focus on land forms and especially how the glaciers of the great ice ages shaped the New England landscape. This is best done by examination of local topographical maps and visits to nearby sites which give evidence of this history.

Suggested readings:

Neil Jorgensen, *A Guide to New England's Landscape,* Barre Publishers, Barre, Mass., 1971.
Betty Flanders Thomson, *The Changing Face of New England,* The Macmillan Co., New York, 1958.
Geological Quadrangle Studies, available from the New Hampshire State Planning and Development Commission, Concord, N.H.

The Water Cycle – Session 10

Leader: Someone working in hydrology, geology, soil sciences, or land management. The U.S. Soil Conservation Service is an excellent source, also colleges and engineering groups—the U.S. Army Corps of Engineers, highway engineers, and construction firms. Towns and cities may also have personnel qualified on this topic, either working for the town or serving on boards or commissions.

This field trip will focus on the water cycle, as exemplified in a watershed in the local area. This should involve a visit to the stream or river to examine flow characteristics, cutting and depositing of material, flood plains, etc. But the trip should also deal with the effects of water in the watershed on the character of the stream. This involves consideration of soil characteristics, grade, erosion, and soil and land use practices.

Suggested readings:

Luna B. Leopold, Kenneth S. Davis, and Editors of Time-Life Books, *Water,* Life Science Library, Time-Life Books, New York, 1970.

Flood Hazard Areas, New Hampshire, Report prepared by Anderson-Nichols and Company for the N.H. Department of Resources and Economic Development, Concord, N.H., April 1967. Free, also accompanying slides which may be borrowed.

A Curriculum Activities Guide to Water Pollution and Environmental Studies, Tilton School Water Pollution Program, Tilton, N.H., 1970.

Local soil maps or other relevant studies prepared for towns by the Soil Conservation Service, Geological Survey, and/or U.S. Army Corps of Engineers. Available in municipal offices.

"Liquid Assets," *The Curious Naturalist,* Massachusetts Audubon Society, Lincoln, Mass., March, 1971.

Mathematical Techniques – Session 11

Leader: Experienced teacher from school system or someone involved in teacher training.

Collecting, recording, and interpreting data are basic elements of any inquiry or investigatory process based on observation. The purpose of this session is to introduce aides to techniques that can be used by elementary students in environmental studies: simple procedures for recording information, graphs, measures, estimating, sampling, etc. During the session aides should themselves go through several activities (i.e., sampling, or estimating the area of a leaf*). Other techniques, such as measuring stream flow,** should be built into other sessions as appropriate. Examples of environmental activities which include mathematics as an important component are given in the references below.

Suggested references:

*Environmental Discovery Series, National Wildlife Federation, Washington, D.C., 1972. See units: Sampling Button Populations and Differences in Living Things. See other titles in bibliography. Excellent.

**John Hug and Phyllis Wilson, *Curriculum Enrichment Outdoors,* Harper and Row, New York, 1965. Special section on mathematics outdoors, good general source.

John M. Youngpeter, *Winter Science Activities,* Holiday House, New York.

Pictorial Representation, Nuffield Mathematics Project, published for the Nuffield Foundation by John Wiley & Sons, Inc., New York, 1967.

Graphs Leading to Algebra, Nuffield Mathematics Project, published for the Nuffield Foundation by John Wiley & Sons, Inc., New York 1969.

Instructo Teaching Transparencies (i.e., for Grafts—No. 839, or Measurement—No. 845), Instructo Products Co., Philadelphia, Pa. Similar transparencies (Math 5T-5W) are also sold by Minnesota Mining and Manufacturing Co.

Minnemast and ESS units are also available on these topics. See bibliography.

Curriculum Applications in Language Arts and Social Studies – Session 12

Leader: Experienced teachers who can present projects they have carried out with students.

The purpose of this session is to emphasize that environmental studies are appropriate and should be included in the total curriculum, not just the sciences area. The various opportunities can be explored by means of several "live" presentations, supplemented by take-home materials suggesting other activities.

One Hanover program that stimulated much interest came from a sixth grade language arts teacher whose class had worked with cameras on an environmental theme. She showed three delightful slide programs which the children had created, complete with taped dialogue and music. She also had a winter class which had gone out on snowshoes with cameras. The resulting display of "Designs of Winter" was truly beautiful. This led to discussion of other projects, some of which are given on page 48.

Another type of project which is most important is that of "problem solving." Professor William Stapp of the University of Michigan has spoken in New Hampshire and written widely* (see suggested readings) on the importance of children being given the chance to do something about environmental problems which they perceive. He feels that every year, K - 12, every child should have at least one opportunity of dealing with some problem appropriate to his own interests and age level. This means carrying his solutions all the way to an action stage and seeing results. This might involve planting spring bulbs to beautify the school, picking up litter, recycling, putting up bluebird houses, making an all-weather path to keep out mud, marking a nature trail to prevent trampling of surrounding areas, other landscaping projects,** water testing of nearby streams, etc.

The aim of environmental studies is "to develop a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, knows how to help resolve them, and is motivated to do so." Educators still do not know what creates that "motivation to act." But, intuitively, early success in perceiving and acting on problems must have an important role.

Suggested readings and references:

"Environmental Encounters," No. HE 5.210:10079, Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Send ten cents for each.

"An Approach to School Site Development," Film which may be rented for about $12.50 from International Film Bureau, Inc., 332 S. Michigan Ave., Chicago, Ill. Shows students completely landscaping school grounds, with projects related to many curriculum areas.

John W. Hug and Phyllis J. Wilson, *Curriculum Enrichment Outdoors,* Harper and Row, New York, 1965. All discipline areas represented, plus games.

Virginia W. Musselman, *Learning About Nature Through Games,* Stackpole Books, Harrisburg, Pa. Prepared for National Recreation and Park Association.

Matthew J. Brennan, ed., *People and Their Environment: Teachers' Curriculum Guide to Conservation Education* J.G. Ferguson Publishing Co., Chicago, 1968, 1969. Eight-guide series, grades 1-12, science and social studies, builds concepts based on structured, activity-oriented lessons.

William Stapp et al, "The Concept of Environmental Education," *Environmental Education,* Dembar Educational Research Services, Inc., Madison, Wisconsin, fall 1969.

Language Arts Activities, prepared by teacher Barbara Humm, Hanover

1. The teacher can have each child bring back a treasure from the woods to put in a mystery bag. One class can prepare bags for another. In class pass out bags to children in a circle. With closed eyes, each child in turn can describe his object to others. One child can draw the object on the blackboard as it is described. This encourages accurate and detailed description. Class members try to guess what is being described.

2. Go to the woods to hear a story read or to do a play.

3. Each child can be assigned to bring in a nature object from his neighborhood. Pair up the children and have them write a comparison between their two objects considering size, shape, and texture, as well as function. (This can be the development of a lesson in comparison and contrast.)

4. When back in class after a walk, have students make a list of possible animals whose clues you have found. Write a story about one of the things you saw (or imagined from things you saw):

   a. a leaf who was chased by a squirrel
   b. a rabbit who ate a family's garden lettuce
   c. an autumn leaf's adventures on its fall to the ground
   d. the life story of a tree who has been pecked by woodpeckers

   You become the leaf or the rabbit or the leaf or the tree.

5. Take a walk with cameras to record patterns, textures, and shapes in nature. Children can share cameras and each take six pictures (of twelve on an Instamatic roll). When pictures are developed and returned, mount them on colored paper. On the paper also list as many words as possible to describe the texture, pattern, and shape.

6. The teacher can take slides of some scenes of objects in nature and have the children write stories about them after being viewed in class. Have the children become the plant or animal in the slide.

7. Environment: Write a story about your favorite organism and his friends. Where do they live? What do they do with their time? How do they fight and get their food?

8. Populations: How does it feel to be a member of a population of crickets instead of people? Be the cricket and tell about your relatives, where they go in a rainstorm, what you do in winter, what you eat, how long you live, and how you have children.

9. Life cycles: On your walk to find seeds, talk about hitchhiking ones. When back in class search for burrs on children's clothing. Write about the seed's adventures from field trip to school to home. You become the burr.

10. Organisms: Using one of the organisms you observed, design a game which you might play if you were that organism. You can get ideas from games you play, but remember that their physical abilities are different from yours.

11. On a rainy day go out with galoshes and raincoats for a walk. Talk about where rain comes from. When back in class, have students be Ruth the Raindrop and tell her life story.

12. Have students on a nature walk each find a private territory to observe for fifteen minutes. List the sounds heard and the sights seen. Choose one you have never noticed before, and, when back in class, write a haiku poem on it.

13. Write a poem starting with this line: "I had a dream where I was an ant, or anything else!"

Social Studies Activities

1. Look for ways man has changed his environment. Take younger children on a trip to a tower for a "bird's-eye" view of their town or neighborhood. They should discuss what is natural and what has been changed by man. They might obtain pictures of how their town looked at some time in the past. Children might also go on a visit to the town clerk to find out what the population has been at various times in the past. They could predict what the town will look like when there are twice as many people, when they are ___ years old. (Clerk should be able to give estimated figure.)

2. Children could visit one or more places that affect the present character of the town, i.e., an operating farm or dairy, lumbering operation, factory, supermarket, or superhighway exit to the town. They could look for ways people of their town have tried to preserve the quality of life in the town, i.e., a sewage treatment plant, parks, wildlife sanctuaries, water reservoir, public gardens, tree-lined streets, trash barrels.

3. Children could discuss what they do or do not like in their town or neighborhood. Include sights, smells, sounds, feelings about places and things. If cameras are available, take "candid camera" pictures for exhibition or contests. Use tape recorders for sounds.

4. Count numbers of automobiles passing the school or any given point at various times of the day. Predict changes on town or neighborhood with increase in population and/or numbers of cars if people of the town choose to have more than one automobile.

5. Older children may take projected population figures for some future date and try to predict changes required to accommodate them. Include additional schools, fire equipment, sewage treatment, water resources, open park and recreational facilities, additional stores, hospital facilities, parking spaces, roads, etc., as appropriate. Have children examine facilities for present adequacy, and interview appropriate community people for information and projections.

6. Have children measure the area covered by a parked car and calculate the area in square feet. Find out from the town clerk or police department the total number of registered cars in the town. Then figure out the total area of the town required just to park the cars of the people that live there. To get a more complete idea of the area of the town devoted to the automobile, measure all or the major parking lots in the town. Get figures from the clerk or annual town report as to number of miles of roads. Measure and obtain figure for average width of town roads. Calculate the total area of the town covered by roads and parking lots. Together with the area of land needed just to park the private cars at their homes, the approximate area of town land devoted to the automobile is known (much still left out, since private driveways, extra home parking space, etc., not included). Then ask, "At the future date of _____ when you are _____ years old, what will be the estimated number of cars (from clerk)? How much space will they require just for parking? Can you estimate the total space that will be needed for automobiles?"

7. Find out the present number of local automobile registrations. Have each child ask his father how many miles the family car(s) was driven last year. At fifteen miles to the gallon, convert to the number of gallons of gasoline used. Take some pollutant given off in auto exhaust, i.e., 2 gms of lead per gallon of gasoline. Calculate the amount put out by a single car in one year. (1,000 grams equals 2.2 pounds) to obtain enough lead weights (from hardware store or fishing supplies) to add up to the calculated total. An exhibit might be made for the school or for the local store windows. A total might be reached for the total lead put into the air by the families of all the children in the class, or the figure might be estimated for the town.

8. Have the children make a list of all the food they eat for three days. Then have them find out which of these foods came from their own town or state.

9. Have children weigh or find out the amount of meat their family eats in one week. In New England it takes approximately three acres of land to grow one hundred pounds of meat. Have each child calculate the amount of land needed to provide his family with meat for one year, and each individual in the family. (1½ to 2½ acres per person is a reasonable estimate). Multiply the figure for the individual times the population of the whole United States—if everyone is to eat as much meat as he does. Compare with the total land in the U.S. usable for all food growing. Do the same for the whole world (3.5 billion population, 16 billion acres potentially usable—best half now in use). "If the population of the world doubles in thirty-five years, as it is expected to do, what will be the number of acres needed just to grow meat if everyone is to eat as well as you?"

10. Have each child measure the amount of water he uses in one day, i.e., drink, bathtub, to flush toilet, for washing clothes, for brushing teeth. Figure out ways to measure everything possible. Lead into discussion of water used but not included (i.e., in preparing food, putting out fires, watering garden, washing car, by doctors, etc.) that directly benefit him. Total water demand resulting from home consumption may be estimated for the town.

11. Likewise have each child weigh all the refuse and garbage his family puts out in one week. Again, is that all the waste produced from activities directly for his benefit? Totals may be combined for the town. Take a trip to the town dump.

12. Calculate the energy, in gallons of oil, used by a family in one year. Have each child itemize everything requiring energy (electricity and oil) used by his family and, with the help of his parents, find out the following: the number of gallons of heating oil for their furnace; the number of gallons of gasoline used in family car(s), snowmobiles, lawnmowers, snowblowers, etc; the number of kilowatt hours of electricity used (100 kilowatt hours equals three gallons of oil); etc. Again the personal consumption total will not include everything used for the family. Total demand, the choice made by each child's family, can be related to national and/or world demand. This can lead into discussions of limited resources and pollution effects.

Prepared for New Hampshire-Tomorrow
by the Hanover Conservation Council
and the Regional Center for Educational Training

Scavenger Hunt

Select five to fifteen items from the list below, according to the time allotted for the hunt and the objectives of the activity. Through choice of items, the teacher may initiate, implement, or extend a classroom or field study program.

Instructions such as the following should be given: LEAVE NATURE UNDISTURBED! Objects of the hunt are to be brought back only if they are nature's "discards".

Describe each item in the following ways:

1. Give written description or draw picture.
2. Give name if known.
3. Record specifically where item was found. Compass may be used.

Total points will be given on the basis of the number of items and quality of the description.

Total possible points	To be found
3	Three kinds of living things on a fallen tree or log
2	An ants' nest
3	Five signs of spring (different from other seasons)
2	Three geometrical shapes or patterns in nature (i.e., star, circle, triangle)
3	A spider web
2 each	Organisms such as a crayfish, water strider, grasshopper, spider, caterpillar, cocoon, inch worm, tadpole, salamander, red eft, wood toad, tree frog
5	Five different kinds of ferns. Note differences.
2 each	Identify or describe any kind of animal, except birds, and give habitat where found
2 each	Animal home or "nursery". Do not touch. Describe.
2 each	Identify or describe any birds seen, habitat where seen, and activity when seen
1 each	At least five different things that were once alive
1 each	Each kind of pollution caused by man
3	Three objects of nature with number pattern of three, four, or five
2 each	Examples of soil erosion, each from a different cause or in a different location
3	Three different kinds of nature's "discards"
2	A plant which will produce something good to eat
2	A pine tree, if you can tell how old it is
3 each	For each distinct micro-climate (little climate) you can find, record for each: distinguishing characteristics, such as light, temperature, and moisture; and three associated life forms
2	Two kinds of moss that look different
2	A plant which will cause pain or distress
2	Two kinds of tree flowers or catkins

Total possible points	To be found
1 each	For each wildflower found, describe blossom, draw picture, give name if known and habitat where found
2	Two things carried by the wind
2	Three different kinds of stones and where found
5	Three different kinds of evergreens
6	Three different kinds of soil. Describe texture, moisture, smell, color, and feel
3	Something rough, soft, wet, smooth, other
5	Three different kinds of deciduous trees
3	One object of nature with symmetrical shape and one with non-symmetrical
3	A bird feather (any kind)
3	Five sounds of nature
3	Five smells of nature
2 each	For each living plant that is not green
1	A round leaf
1	A leaf that is more than twice as long as it is wide
2	Three leaves with different types of edges
6	Three different tree seeds
5	A bird's nest. Do not touch before fall.
2	A rock that is shiny
2 each	For each set of animal tracks found and described
1 each	For evidences that animals or insects have been eating
2	Two plants in deep shade
2	Two plants in bright sun
2	Two plants in moist woods in damp soil
2 each	Two plants which live together and help each other
1 each	Fruits of trees
extra points	For anything you have never seen before. Describe in the same way you did the objects of the hunt and draw pictures.

Prepared by
the Hanover Conservation Council

Excerpts from
LEARNING ABOUT NATURE THROUGH GAMES
by Virginia W. Musselman

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Secret Numbers

A two-way treasure hunt. The youngsters must find all the notes placed around the area, whether backyard, camp, playground, street, or other neighborhood spot. They must also come back with the right score. *You*, of course, have already gone over the area and know the answers.

This is a particularly good type of hunt because it promotes careful observation, stimulates curiosity, and is an exciting game all at the same time.

Number the notes. *Players must find them in order;* no one can open note # 3 until he has found and read # 2. This sort of hunt can be played with even one child. If more, send them out in small groups of twos and threes.

The notes can include such observations and instructions as:

Note #1: Line up at the fence and walk carefully forward, counting your steps, until you see an anthill. Write down the number of steps you took.
Note #2 (at the ant's nest): If the ants in this hill are all black, add 100; if they are partly red, add 500. Turn to the right and walk carefully until you see a spider's web.
Note #3 (near the web): If all the threads in this web are sticky, add 5. Look around you and walk to the nearest tall tree.
Note #4 (at the tree): If you see one bird's nest in this tree, add 10; if you see three nests, add 30; if you see none, add 100. Walk back to the path and look for a snakeskin along the edge.
Note #5 (near the snakeskin): If this snakeskin is right side out, add 10. If it's wrong side out, subtract 10. Walk down to Mr. So-and-So's field (or yard).
Note #6 (near the edge of field): Look for weed seeds. Add ten for each different kind that can stick to your sweater or socks. Walk down to the road (or sidewalk).
Note #7 (at edge of road or sidewalk): Find a stone that will make a yellow mark on the sidewalk. It is probably limonite, an iron ore. Add 10 if you find it. Come back to the starting place and add up your score. If it is less than 500, look *up* and find the treasure. If it is over 500, look *down* and find it.

Variation # 1: Secret numbers can be made easier or more difficult, to suit the nature information level of the players. Other notes might read like these, and need not have a time limit.

Note #1: This tree is a white pine. The secret number equals the most common number of needles found in each bundle on this tree. The next note will be found at the base of the largest tree you can see to the south of this point.
Note #2: This tree is a sugar maple. If the leaves of this tree are arranged in twos opposite each other on the twig, the secret number is 10. If the leaves are alternate and not opposite, the secret number is 5. The next note will be found under the "skin" of a large stump. Continue south along the trail.
Note #3: Each ring on a stump indicates one year of growth. If this tree was more than fifty years old when cut, the secret number is 20. If the tree was less than fifty years old when cut, the secret number is 10. Continue along the trail and look for the next note in the first drainage pipe under the trail.
Note #4: The secret number is 30. Follow this stream in a downstream direction to the next bridge. The note will be found under a rock on the south end of the bridge.

Some things to keep in mind in conducting a hunt of this kind:

The best game for a group of beginners would be one in which very little actual knowledge would be needed but the success would depend on keen observation.

Use as many kinds of nature materials as possible—stones, trees, work of insects, flowers, bird nests, etc.

This game can be adapted to children or adults by increasing the difficulty of finding clues and making observations.

Blind Game

Everybody is blindfolded. They take turns touching some object with one finger and trying to guess what it is. Use such objects as:

piece of bark	seedpod
vegetable	flowerhead
piece of fur	bird's nest
moss	animal
ice	soil

These quizzes can be turned around and played in many different ways. For example, the leader might say, "If the baby deer is a *fawn*, and its father is a *buck*, what is its mother?" Or "A *cub* and a *vixen* live in a *den*. What is the name of the cub's *father?*" Or "You've heard of *peas* in a pod. What animal group is called a *pod?*"

Animal Groups

Players learn and use the correct words for groups of animals, such as:

sheep (flock)	whales (gam, school, herd)
bees (swarm, colony, hive)	cattle (herd, drove)
ants (colony)	seals (pod, herd)
porpoises (school)	lions (pride)
fish (school, run, shoal)	

Animals—Male and Female

lion (lioness)	bull (cow)
ram (ewe)	buck (doe)
stallion (mare)	dog (bitch)
gander (goose)	boar (sow)
drake (duck)	fox (vixen)
tiger (tigress)	billygoat (nannygoat)
stag (hind)	

Animal Homes

dogs (kennel)	bees (hive)
chickens (coop)	beavers (lodge)
sheep (fold, pen)	pigeons (dovecote)
pigs (sty)	cows (barn, byre, cow shed)
lions (lair, den)	rabbits (hutch, warren, burrow)

Animal Babies

Players must use the right word for the *young* of such animals as:

lion (cub)	seal (calf)
duck (duckling)	deer (fawn)
dog (puppy)	goose (gosling)
horse (foal)	whale (calf)
cat (kitten)	swan (cygnet)
hog (shoat)	bird (nestling)
bear (cub)	goat (kid)
frog (tadpole)	bull (bullock)
mare (filly, foal)	cow (heifer)
elephant (calf)	fox (cub)

Locomotive Walk

Everybody looks for examples of how wild things *move*, using such means as:

wings	fins	spines	tails
scales	legs	muscles	claws

See how many *ways* of moving can be found:

climbing	flying	crawling
jumping	running	rolling
sliding	swimming	burrowing

Other Special Interest Walks

The possibilities of them are almost endless, and every one of them will make any walk or hike more interesting. You don't have to be a naturalist to enjoy any of these. Just use your eyes!

1. *Discards:* Cast skins of insects or snakes, a fallen leaf, a lost feather.
2. *Transportation:* What is carried by such things as wind, fur of animals, people, birds, insects?
3. *Movements:* Clouds; things blown by wind, such as a poppy cup; animals.
4. *Planters of seeds:* Squirrels, birds, insects, mice.
5. *Tracks, signs or traces:* Animal tracks, leaf prints, dung of animals or birds, nibblings as sign of an animal's having been there for a meal.
6. *Patterns or designs:* Circle radiations (feather), star, dot, triangle or wave.
7. *Signs of the times:* What do you see that is evidence that this is *this* season and no other? Specially good when each season is at its peak.
8. *Homes, homemaking and homemakers:* Spiders, birds, moles, gophers, mice, chipmunks, woodchucks, bees, wasps.
9. *Skins or outer surfaces:* Rock surfaces, bark of trees, feathers, fur, scales, frog and salamander skins, leaf surfaces.
10. *Curiosities:* A plant that has pushed up through a dead leaf carrying the leaf with it; other unusual finds.
11. *Freaks and oddities:* A four-leaf clover or sorrel, a two-tailed lizard, an albino animal or bird.
12. *Miniatures:* Tiny, lovely things, or just queer or interesting, such as the fruiting bodies on moss that look like fairy golf clubs; mosslike plants that are studded with tiny umbrellas or jewel cups; seeds with parachutes or propellers; tiny flowers that you never noticed before, etc.
13. *Remnants of yesteryear:* Birds' nests from last year, leaves, ghosts of flowers, fallen seeds, dried grasses.
14. *Squatters:* Who sits on what? (Parasites, mosses and lichens on rocks, etc.)
15. *Inchers:* Hunt for treasures less than one inch tall.
16. *Cycles:* Plant—bud, flower, fruit, seed, seedling. Frog—eggs, pollywog, frog.
17. *Visitors:* Welcome or unwelcome, helpful or harmful, or neither.
18. *Hitchhikers:* Who gets a free ride? Burrs on socks, ants in lunch, fleas on dog.
19. *Climbers:* How do they climb, plant and animal?
20. *Woodland babies:* Young plants and animals.

Sound Dropping

From behind a sheet or curtain, or in another room, drop a series of objects. The children try to identify each by the sound. Use:

coin	tin cup	log	cane
apple	lemon	rock	shoe

Nature Gossip

Everybody sits in a circle. One person starts by saying the name of some animal. The player next to him must add one fact about that animal, and so on around the circle. Anyone who can't add a fact must pay a forfeit, or do a stunt.

Go Get It

Get the children into two teams, A and B, each with a captain, and number off. The teams stand facing each other, Player A1 facing Player B1, and so on. You stand at the end, an even distance between each team.

To start the game, call out something that you can see, or know is nearby, such as "A leaf with smooth edges—Number 5!" Both players # 5 must dash to get a leaf with smooth edges and bring it back to you. The first to do so scores a point for his team.

Then call out some other item, and another player number, and so on. Items might include:

- a white flower
- a pebble that shines
- a tree twig
- a seed
- a nut
- a bit of moss
- a live insect
- a pinecone
- a burr
- a feather

COLOR

The ability to recognize and identify colors can be learned, and the learning can be fun. Learning the exact shade is even more fun, and word-building, too. Encourage a wide color vocabulary by showing color charts. Paint shops are a good source.

I See a Color

One child looks around the area and selects some object in sight. He says, "I see something blue," or whatever color the object is. The others take turns trying to guess it. The first to guess correctly chooses the next object to be guessed.

Variation: To make this a bit harder and more interesting even for young children, add more dialogue, so that It and the others must be even more observant.

It says, "From where I sit (or stand) I see something blue" (or other color). The next person says, "Is it . . . ?", naming something *he* sees that is blue. It answers truthfully, "No, it's not. . . ." Player # 3 suggests something else that is blue, and the game goes on until someone asks about the right object. He then becomes It.

This game is a sort of visual treasure hunt. Children always enjoy it. It's a good game, too, because it requires observation plus color identification.

Color Tours

A walk around any area—backyard or city block, camp or playground—can promote observation and color identification. These are only a few of the many variations:

1. See how many *red* objects can be spotted—any shade of red. Same with other colors, on other color tours. Make a list along the way.
2. See how many *different* colors can be spotted. Make a list.
3. Follow 1 and 2, but don't make a list. See how many can be *remembered* and named after getting back to the starting point.
4. Keep personal progress trends. It's how well the person observes, not the number of items somebody else saw.

Color Wheel

Find a sample of a color wheel in an art store or book. Draw a big one on a large piece of cardboard, and color it.

Then take the group out to find natural objects that match the colors on the wheel, bring them back, and match them up. It may take a long time to fill some of the color sections, but it is fun to work on it.

Tree Bingo

Prepare in advance a list of about thirty names of trees and keep this hidden. To start the game, give each person a large sheet of paper and ask him to draw five lines each way from margin to margin, making twenty-five squares. On a signal, each starts writing the names of as many different trees as he can think of, one in each block, until all the squares are filled. Wait until everybody finishes filling the squares, and give a little prize to the first.

Then read the previously prepared list slowly while each player crosses out on his own sheet the names of trees as read. Anybody who gets five crosses in a row vertically, diagonally, or horizontally, calls "Bingo." Keep on reading until the first vertical, first horizontal, and right and left diagonals have been called.

For other occasions, use the names of animals, or birds, or flowers, instead of trees.

Indian Hike

Go in single file, v-e-r-y carefully. Try not to make a *sound*. Avoid stepping on dry twigs or through dry leaves. Don't talk above a whisper. Stop frequently to *listen* as well as look. What sounds can be heard?

Listen for wind, song of a bird, rustle of some small animal, a distant plane, water running, leaves rustling, squirrel chattering, insect humming. Look for *sources* of all the sounds.

Quizzes like this one and others that follow are second cousins to riddles and other word games. Many depend upon a double meaning, a change of spelling, or a quick mental conclusion. They stimulate quick thinking, memory, and verbalization. Best of all, they are laugh-making. Start with these:

A tree that is a personal pronoun	Yew (you)
A tree found in some churches	Elder
A tree used by fortune tellers	Palm
A tree that is well-groomed	Spruce
A tree denoting something important in history	Date
To waste away in grief	Pine
What tree is nearest the sea?	Beech (beach)
A tree that is the ——— of my eye	Apple
A mythical tree mentioned in the Bible	Life
Name the double tree	Pear (pair)
What tree will hold things?	Box
What tree will keep you warm?	Fir (fur)
The Egyptian plague tree	Locust
The tree used in wet weather	Rubber
The tree used in kissing	Tulip
The tree used in bottles	Cork
The fisherman's tree	Basswood
A tree whose name is a body of water	Bay
A tree used to describe pretty girls	Peach
An emblem of grief	Weeping willow
The sweetest tree	Sugar maple
A tree which means to make accurate, true and upright	Plum (plumb)
A tree whose name means footwear	Sandal
A tree that we chew	Gum
A tree associated with a boy who became a general	Cherry
A tree left in the fireplace	Ash
A tree whose blossoms are worn by brides	Orange
A tree whose name means stone	Lime
A tree that reminds us of Dixie	Magnolia
The canine tree	Dogwood
A tree whose name means a colored wood	Redwood
The favorite tree of Ohio	Buckeye
The tree that the silkworm likes	Mulberry
The tree whose leaf is a nation's emblem	Maple

Food for Thought

Find the nut, fruit, or vegetable:

What fruit is a double?	Pear
What nut is a large strong box?	Chestnut
What vegetable is a machine to raise water plus a relative?	Pumpkin
What fruit is of a Scotch clan?	McIntosh apple
What vegetable is an Indian's wife plus an exclamation of silence?	Squash (squaw-sh)
What nut ought to go well with hot biscuits?	Butternut
What vegetable is a time measure in music?	Beet (beat)
What nut is a sandy shore?	Beechnut
What vegetable is in the alphabet?	Pea
What vegetable is on the breakfast menu, plus a factory?	Eggplant
What vegetable is a reverse plus small bites?	Turnips
What nut is good for dunking?	Doughnut

Weight-Guessing

Pass around several objects of various sizes and shapes. Each person "hefts" them, and writes down his guess as to the weight of each. Use objects such as:

watermelon	rocks	apples
cucumber	head of cabbage	bunch of grapes
a dog	a can	a child

Then bring out the scales and check each object.

Encourage the practice of weight-guessing. It's good training for the senses.

Onion Hunt

One person (or chosen leader) lays out a trail a few minutes before the others follow. He rubs a fresh-cut onion across tree trunks, telephone poles, walls, or other places. The others must "follow their noses." Keep this hunt short, so that the smell of the onion won't disappear too soon.

Quests

Prepare a listing of possible discoveries to be looked for on a trip or hike. If you don't know their *names*, ask for samples that *look* different. For example, "Two ferns that look different," rather than "Two kinds of ferns." You can always look up the names later! Your list might include things like:

two kinds of spider webs
squirrel's summer nest
bird nest not more than six feet from the ground
two kinds of hitchhiking seeds (burrs, etc.)
winged seed
two kinds of mosses
red-winged blackbird (or other bird)
two kinds of ferns
red flower
beetle
animal tracks
three kinds of insects

Variation # 1: Rate the objects in terms of difficulty of finding. For example, spider webs might count five points because they're harder to find, whereas a winged seed might count only one point.

Variation # 2: If played in the backyard or if the trip is around the block, on the beach or in the park, make out a list of objects that can be found by looking hard. Include garden flowers, fruits, ants, bees, weeds, pebbles, shells, birds, etc. They might escape notice, but they are there for seeing eyes to find.

Nature Charades

Divide up into two teams. Each team selects some nature name of not more than five letters, such as lion, bear, frog, duck, etc. In turn, each team dramatizes each letter in the name it has selected. The other team tries to identify each letter, and then guess the name.

Variation # 1: Each team selects the name of a flower, and acts out each syllable. Try these:

touch-me-not	carnation
primrose	dandelion
jack-in-the-pulpit	tulip
foxglove	forget-me-not
lady slipper	four o'clock

Variation # 2: Play this game, using *birds, trees,* or other categories of nature.

Variation # 3: Each team selects the name of a bird, and dramatizes it. Try these:

fly catcher	kite	grosbeak	partridge
thrasher	robin	chickadee	woodpecker

Let-Them-Alone Hunt

The youngsters divide into small groups and each group gets a list of objects common to the area that might be seen on the hunt. The list could include items such as:

A tree that has been struck by lightning	Black ants
A red flower	Red ants
A tree stump more than a foot in diameter	A humming bird
Reindeer moss (or other kinds)	A small waterfall
Animal track	Poison ivy
Mushroom	Sumac tree
Maidenhair fern (or other kinds)	Leaf shaped like a mitten (sassafras)
A plant growing in a rock crevice	Flowering dogwood leaf
A bird's nest	Non-flowering dogwood leaf
A squirrel's summer home	White birch
	A hawk

The hunters go together as a group. As soon as a player spots one of the objects on the list, he shouts it out, and his group gets credit. Easy-to-spot objects count one point; rarer objects two or three points.

Museum and Library Resources – Session 13

The purpose of this session is to introduce aides to local resources of books, curriculum materials, and natural history collections which may be useful in environmental studies.

Becoming familiar with library resources is best accomplished by having the aides spend a few hours browsing at their own convenience. The librarians might be willing to set up displays or indicate those sections where appropriate materials can be found.

If at all possible, arrange a conducted tour of the best local museum or resource center. This might include some instruction on preserving natural materials and setting up displays.

Suggested references:

John R. Saunders, *Golden Book of Nature Crafts - Hobbies and Activities for Boys and Girls,* Simon and Schuster, New York.

R.O. Bale, *Creative Nature Crafts,* Burgess, Minneapolis, 1959.

Vinson Brown, *The Amateur Naturalist's Handbook,* Bramhall House, New York.

Kenneth R. Benson and Carl E. Frankson, *Creative Nature Crafts,* Prentice-Hall, Englewood Cliffs, N.J., 1968.

Z. Subarsky, E.W. Reed, E.R. Landin, and B.G. Klaits, *Living Things in Field and Classroom,* Minnesota Mathematics and Science Teaching Project, University of Minnesota, 1967. Setting up displays.

Field and Forest in Winter – Session 14

Leader: Naturalist, experienced field leader, anyone who spends time outdoors in winter and can interpret the winter scene–biologist, ecologist, cold weather specialists. Good sources, in addition to colleges and schools, are the Fish and Game Department, hunting clubs, forestry experts, Cold Regions Research and Engineering Laboratories (Hanover, N.H.), Audubon Society.

The objective of this session is to get aides out on snowshoes and to help them become aware of the wealth of outdoor activities that exist in winter. The session may go in any direction depending on the interests and experience of the leader: ice and snow, water content of snow cover, effects of cover on ecological communities, animals and trees in winter, etc.

Suggested readings:*

John M. Youngpeter, *Winter Science Activities,* Holiday House, New York, 1966.

David Webster, *Snow Stumpers,* Natural History Press, 1968.

Franklyn Russell, *Watchers at the Pond,* Alfred A. Knopf, New York.

"Let's Build a Snowhouse," *Natural History,* December 1946, p. 460.

"An Eskimo Girl Builds a Snowhouse," *Natural History,* January 1943, pp. 46-47.

Vilhjalmur Stefansson, *Arctic Manual,* Macmillan, New York, 1944, pp. 161-190. Also, in appendix eight photographs and diagrams of snowhouse construction. There is a Stefansson library and collection at Dartmouth College, Hanover, N.H.

*Suggestions contributed by Warren Little of Liberty Council of Schools (P.L. 89-10 Title III), Mass. Audubon Society, Lincoln, Mass.

Information sheets put out by the Massachusetts Audubon Society, Lincoln, Mass.: "A Method of Preserving Snow Crystals," "Classification of Solid Precipitation," "Some Information on How Animals Spend the Winter," "Animal Tracks," "Animals in Winter," "Common Winter Birds in New England."

The Curious Naturalist published nine times a year by the Massachusetts Audubon Society:

Vol. I, No. 4, "Animals in Winter"
Vol. I, No. 5, "Feeding Birds in Winter"
Vol. II, No. 3, "Hibernation"
Vol. II, No. 5, "Snow Geology"
Vol. II, No. 6, "N.E.'s Longest Winters"
Vol. III, No. 5, "Forest Community"
Vol. IV, No. 6, "Some Cold Weather Birds of the Field"
Vol. V, No. 5, "Food Chains and Webs"

Pamphlets published by the National Audubon Society, 1130 Fifth Avenue, New York: "Winter Sleep - Animals that Hibernate," "Track Stories in Mud, Sand, and Snow," "The Ways of Wildlife in Winter"

Phyllis S. Busch, *A Walk in the Snow*, J.B. Lippincott Co., Philadelphia, 1971.

CLASSIFICATION OF SOLID PRECIPITATION : Snow, Sleet and Hail

Code	Graphic Symbol	Term	Typical forms
1	⬡	Plates	
2	✳	Stellar crystals	
3	▭	Columns	
4	↕	Needles	
5	⊛	Spatial dendrites	
6	⊏|	Capped columns	
7	◡◠	Irregular crystals	
8	△	Graupel-snow pellet	
9	△	Sleet-ice pellet	
0	△	Hail	
m	✳	Broken	Partial crystal
r	✳	Rimed	Ice granules
f	(✳)	Flake	Clusters
w	✳	Wet	Partially melted
a	0.0-0.49 mm	Very small (Actual Size)	Size means greatest dimension of a single particle or average size of crystals composing a flake.
b.	0.5-0.99 mm	Small	
c	1.0-1.99 mm	Medium	
d	2.0-3.99 mm	Large	
e	4.0-or larger	Very large	

PROJECT: Storm record

For each snow storm catch a few of the crystals on a piece of black cloth and look at them quickly with a hand lens. Record crystal type, characteristics, and size by code. Note and record changes in snow types during storm. To determine water content of snow, melt a given volume and compare amount of melt water to the original amount of snow. Compare data for different storms.

Date of storm					
Type of crystals					
Char. & sizes					
Water content					

For "Preservation of Snow Crystals" see Jan. 1963 Curious Naturalist Massachusetts Audubon Society, So. Lincoln, Mass.

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Material compiled by D.R. Miner from "The Formation of Ice Crystals" by Ukichiro Nakaya, and "Snow and its Relationship to Experimental Meteorology" by Vincent J. Shaefer, in Compendium of Meteorology, edited by Thomas F. Malone, American Meteorological Society, Boston, Mass., 1951. With permission.

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EDUCATION DEPARTMENT, MASSACHUSETTS AUDUBON SOCIETY, S.LINCOLN,MASS.

Final Session – Session 15

Leaders: Course staff, program director.

This final session should be informal and open-ended, providing aides and course staff with ample opportunity for discussion of the aide course, the whole volunteer program, the experiences of aides to date in working with teachers, and what comes next. It is very important for learning and morale to deal openly with the questions that come up in getting any such program going, especially when teachers and aides are just learning to work together effectively. What do you do with unruly little boys? What if you have too many children to handle outdoors? What about the teacher who goes off to have coffee every time you appear? What about the hunting season, and should you take a field trip in the rain? These and many other questions will undoubtedly arise and need to be discussed.

End the class with a planning session for "practice teaching" projects. Ask each aide trainee to undertake a project with a teacher. Two or three aides may work together as a team, if desired. Before the last session the course director and program coordinator will have identified and talked to a number of teachers interested in having aides work with them. They will have found out about general subject areas to be studied and any outdoor projects already planned. Aides may choose the subject area they would like to work on and link up with the interested teacher. Aides and teacher will then work together in planning and carrying out some project of at least three sessions, with help and advice from the course staff as needed.

Periodic follow-up sessions with aides, or aides and participating teachers, will be highly useful. Projects can be displayed, problems discussed, and successes enjoyed by all. Learning to be a good environmental aide and building effective teaching teams must be a continuing and long-term process. However, it is only through such sustained efforts that teachers and schools can offer today's children the kind of environmental education they will need for tomorrow's world.

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This is not intended to be a complete bibliography for an environmental studies program. Rather it is a limited list of reference materials and curriculum guides which may be useful in an aide training program. The following more inclusive and annotated bibliographies are readily available.

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3. *Environmental Education Bibliography.* Massachusetts Audubon Society, South Great Road, Lincoln, Mass. 10773. Three sections: K-3, 4-6, 7-9.
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March 1971

By: Division of Instruction
N.H. Department of Education
Concord, N.H. 03301

Resource People and Agencies in New Hampshire

Most of the agencies listed below are sources of free or inexpensive material on conservation, population, and/or ecology. These include publications, films, slides, exhibits, posters, and curriculum guides. A few of these agencies will also supply speakers, resource personnel, and provide teacher training workshops. Most of the agencies will supply lists of the materials and services they provide.

A comprehensive list of New Hampshire agencies is contained in the "New Hampshire Conservation Directory". This directory is available at a cost of 50 cents from SPACE, Box 757, Concord, N.H. 03301, or from the Society for the Protection of New Hampshire Forests, 5 South State Street, Concord, N.H. 03301.

Air — Air Pollution Control Commission, Air Pollution Control Agency, 61 South Spring Street, Concord, N.H. 03301. (Tel. 271-2281)

Water — Water Supply and Pollution Control Commission, Prescott Park, 105 Loudon Road, Concord, N.H. 03301. (Tel. 271-3502)

Water Resources Board, State House Annex, Concord, N.H. 03301. (Tel. 271-3406)

Soil — Soil Conservation Service, U.S. Department of Agriculture, Federal Building, Durham, N.H. 03824. (The SCS also maintains an office in each county with technical field staff.)

Cooperative Extension Service, Taylor Hall, Durham, N.H 03824 (Tel. 862-1520) (The CES also maintains an office in each county. A county agricultural agent and county forester are located in each of the county offices.)

Belknap County – Laconia	524-1737
Carroll County – Conway	447-5922
Cheshire County – Keene	352-4550
Coos County – Lancaster	788-4961
Grafton County – Woodsville	747-2377
Hillsborough County – Milford	673-2510
Merrimack County – Concord	225-5505
Rockingham County – Exeter	772-4711
Strafford County – Rochester	332-5808
Sullivan County – Claremont	543-3181

Forest — United States Forest Service, Department of Agriculture, White Mountains National Forest, Box 638, Laconia, N.H. 03246. (Tel. 524-6450)

Cooperative Extension Service. (See listing under Soil.)

Forest (cont.) United States Forest Service, Department of Agriculture, Northeastern Forest Experiment Station, Box 640, Durham, N.H. 03824. (Tel. 868-5576)

Division of Resources Development, State Forestry Agency under the Department of Resources and Economic Development, State House Annex, Concord, N.H. 03301. (Tel. 271-2215)

Parks Division of Parks, Department of Resources and Economic Development, State House Annex, Concord, N.H. 03301. (Tel. 271-3254)
(Two parks have specific ecological units. One is the Nature Center at Bear Brook State Park, run in cooperation with the Audubon Society of New Hampshire. The other is the Monadnock Ecocenter, run in cooperation with the Society for the Protection of New Hampshire Forests.)

Lost River Reservation, North Woodstock, N.H. 03262. (Owned by the Society for the Protection of New Hampshire Forests. Contains a natural history museum, a wildflower-nature garden, and a self-guiding nature trail.)

Wildlife New Hampshire Fish and Game Department, 34 Bridge Street, Concord, N.H. 03301. (tel. 271-3422) Contact Chief of Information and Education.

Minerals Department of Resources and Economic Development, State House Annex, Concord, N.H. 03301. (Tel. Division of Economic Development - 271-2343
Division of Resources Development - 271-2216)
(Will supply a list of available publications on mines, mining, and geological structure of the state.)

Educational Otter Lake Conservation School, Greenfield, N.H. 03047. Wally Stone, Director. (Tel. 547-3412) (Runs a camping program.)

Regional Center for Educational Training, Wilson Hall, Hanover, N.H. 03755. (Tel. 643-4564)

Spruce Pond Camp, Bear Brook State Park, Allenstown, N.H. 03275 (A youth conservation camp conducted annually by the Society for the Protection of New Hampshire Forests.)

Teachers-Adult Youth Leaders Conservation Camp, Cardigan Mountain A.M.C. Lodge, Alexandria, N.H. (A workshop conducted annually by the Society for the Protection of New Hampshire Forests.)

Day Laboratory in Conservation, Outdoor Education, and Field Science. (An all-day field trip to Bear Brook State Park conducted by the Society for the Protection of New Hampshire Forests for school groups on school days.)

Alvord Wildlife Sanctuary, Bear Island, Lake Winnipesaukee. (A 250-acre sanctuary offering two courses in conservation education for conservation teachers, science teachers, and camp counselors. Operated by the American Humane Education Association through Plymouth State College, Plymouth, N.H.)

Educational (cont.)

Appalachian Mountain Club; North Country System, North Country System Headquarters, Pinkham Notch Camp, Gorham, N.H. 03581. John B. Nutter, Coordinator of Environmental Education. (Tel. 466-3379)

Squam Lakes Science Center, Holderness, N.H.

New Hampshire Department of Education, Room 410, State House Annex, Concord, N.H. 03301. William B. Ewert, Consultant, Science Education. (Tel. 271-3293)

General

Society for the Protection of New Hampshire Forests, 5 South State Street, Concord, N.H. 03301. (Tel. 224-9945)

Audubon Society of New Hampshire, 63 North Main Street, Concord, N.H. 03301. (Tel. 224-1896)

New Hampshire Federation of Garden Clubs. (Contact local club found in most New Hampshire communities.)

New Hampshire Federation of Women's Clubs. (Contact local club found in most New Hampshire communities.)

New Hampshire Tuberculosis and Respiratory Disease Association, Box 1014, 456 Beech Street, Manchester, N.H. 03105. (Tel. 669-2411)

New Hampshire Division of Pesticides Control, State House Annex, Concord, N.H. 03301. (Tel. 271-3550)